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PROCEEDINGS 36TH YEAR

JOURNAL

OF THE

AMERICAN WATER WORKS ASSOCIATION

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AMERICAN WATER WORKS ASSOCIATION

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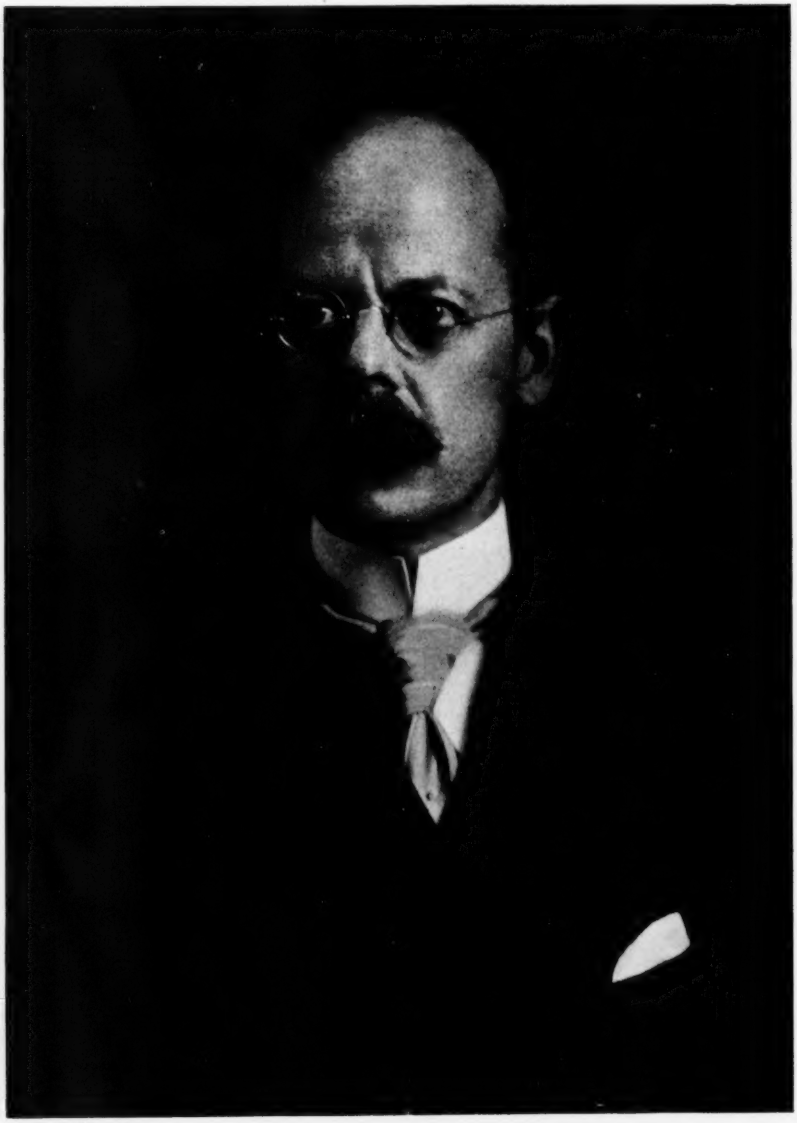

Leonard Metcalf, President 1916-1917

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AMERICAN WATER WORKS ASSOCIATION

The Association is not responsible, as a body, for the facts and opinions advanced in any of the papers or discussions published in its proceedings.

VOL. 3 SEPTEMBER, 1916 No. 3

PROCEEDINGS THIRTY-SIXTH ANNUAL CONVENTION, AMERICAN WATER WORKS ASSOCIATION

The Thirty-Sixth Annual Convention of the American Water Works Association was held at the Hotel Astor, New York City, June 5–9, 1916, Mr. Nicholas S. Hill, Jr., of New York City, presiding.

FIRST SESSION, TUESDAY MORNING, JUNE 5, 1916

The Convention was called to order at ten o'clock a.m. by the President.

The reading of the minutes of the last convention, which had been printed in the JOURNAL, was dispensed with; and the registration of members present in the office of the secretary was made the roll of members present.

Registration

Active and Corporate members	416
Associate members and representatives	222
Ladies and guests	460
Total registration	1098

Of the guests registered 51 were from New York City, including Brooklyn and other boroughs.

REPORT OF CANVASSING COMMITTEE

The committee appointed to canvass the ballots for the election of officers for the ensuing year reported 386 votes cast for President, 381 votes cast for Vice-President, and 381 for Treasurer, all of which were cast respectively for Leonard Metcalf for President, Theodore A. Leisen for Vice-President and James M. Caird for Treasurer. For Trustees 705 votes were cast, of which F. W. Cappelen and M. L. Worrell received the highest number. The above mentioned were therefore declared elected to the respective offices for the ensuing year.

REPORTS OF STANDING COMMITTEES

FINANCE COMMITTEE

To the American Water Works Association:

Your Finance Committee respectfully report as follows:

We have audited the books of the Secretary and the Treasurer, and find them correct. We have examined and verified the vouchers.

There was on hand at the beginning of the fiscal year

April 1, 1915	$ 4,268.15	
There was received from the secretary	11,060.99	
Making a total of		$15,329.14
There has been disbursed and paid, by vouchers duly authorized and audited by the finance committee, for general operations of the association	$8,131.68	
There has been invested in the permanent fund	4,072.50	12,204.18
Leaving a balance in bank to the credit of the association of		$ 3,124.96

We have certificate showing deposit of this money to the credit of the Association in the Troy Trust Company.

There are now in the hands of the Treasurer, in accordance with authority granted to the Finance Committee by the Executive Committee, municipal bonds of par value $4000; $2000, 5 per cent Mercer County, West Virginia, bonds; and $2000, 5 per cent Dominion of Canada bonds.

This marks the beginning of a new financial era in the history of the American Water Works Association; and it is hoped that subsequent additions may be made to the Permanent Fund of the Association from year to year, thus making it possible for it to broaden its activities in the service of water works men.

You will find in the detailed report of the Secretary the items or headings under which the various disbursements of the Association have been made during the past fiscal year. It is gratifying to note that all of the committees have kept safely within the budget allowances, made at the beginning of the fiscal year.

Your committee recommends that the system of making an annual budget, inaugurated last year, be continued, and that the following amounts be appropriated from the receipts of the current fiscal year for the conduct of the business of the Association, viz.:

Budget recommended for 1916–1917

(1)	Convention	$700
(2)	Office expense and postage	700
(3)	Election	75
(4)	Committees	400
(5)	Sections	500
(6)	Office equipment	50
(7)	Insurance	50
(8)	Rent	120
(9)	Salary of secretary and editor	1800
(10)	Printing, distribution and all other charges incurred in publishing the Association JOURNAL, except salary of editor	5000
(11)	Contingent	500
		$9895

Your committee acknowledges with pleasure the hearty coöperation of the Secretary and other officers of the Association in the successful introduction of the budget system

Respectfully submitted:

H. E. KEELER, *Chairman*,
HOWARD A. DILL,
HENRY B. MORGAN,
Committee.

Without objection, the report was received and the recommendations concurred in.

TREASURER'S REPORT

Troy, N. Y., April 1, 1916.

Mr. H. E. Keeler, Chairman Finance Committee, The American Water Works Association, Chicago, Ill.

Dear Sir: Permit me to submit my report as Treasurer of the American Water Works Association for the year ending March 31, 1916.

The funds of the Association are on deposit with the Troy Trust Company, Troy, N. Y., as per the order of the Executive Committee.

The receipts during the year were as follows:

Balance, April 1, 1915	$4,268.15
Received from J. M. Diven, Secretary	10,876.83
Interest on bank deposits	134.16
Interest on investments	50.00
Total	$15,329.14
Disbursements:	
Cancelled checks and collection charges	12,204.18
Balance, April 1, 1916	$3,124.96

The interest on the daily bank balance during the year was $134.16, which was $45.59 more than during the previous uear.

Attached you will find certificate of the Troy Trust Company, showing a deposit of $3,189.86 at the close of business on March 31, 1916. From this balance there should be deducted the following unreturned checks:

Deposit as per certificate		$3,189.86
Unreturned checks:		
V640-ck 807 Edward Bartow	$53.10	
V637-ck 808 Williams & Wilkins	11.80	64.90
Balance		$3,124.96

The cancelled checks and receipted vouchers with the book of the Treasurer are submitted for audit.

During the year Mercer County, W. Va., road bonds of the par value of $2000 were purchased for the Permanent Fund and are in the hands of the Treasurer.

There was also purchased Government of the Dominion of Canada bonds of the par value of $2000. At the present time these bonds have not been turned over to the Treasurer.

When the last mentioned bonds are received by the Treasurer there will be in the Permanent Fund bonds of the par value of $4000.

The Treasurer is under $5000 bond as per the order of your committee.

It is to be hoped that the financial condition of the Association will be such during the coming year that the amount of the permanent investment fund can be increased.

Respectfully submitted,

J. M. Caird,
Treasurer.

SECRETARY'S REPORT

Financial Statement

Cash on hand April 1, 1915		$4,283.60
Receipts:		
Initiation Fees		715.00
Annual Dues		6,790.00
Advertisments in Journal		2,519.00
Sales of Journal		87.58
Subscriptions to Journal		96.50
Sales of Back Numbers of Proceedings		56.07
Authors Copies of Papers		.10
Sales of Report of Committee on Water Rates		13.50
Sales of Specifications for Cast Iron Pipe		34.57
Sales of Hydrant and Valve Specifications		1.80
Interest on Investments and Deposits		109.71
Sales of Association Badges		28.00
Sales of 1914 Binding Cases		5.95
Total		$14,741.38
Disbursements:		
Office Expenses	$631.97	
Convention Expenses	535.32	
Printing Journal	3,928.77	
Committee Expenses	114.34	
Salary of Secretary-Editor	1,750.00	
Election Expenses	63.10	
Rent of Store Room	140.00	
Insurance	35.00	
Section Expenses	221.80	
Advertising, for New Members	191.92	
Binding Cases for 1915 Journal	14.10	7,626.32
Balance		$7,115.06
Investment in Securities		4,000.00
Cash on hand March 31, 1916		$3,115.06

MEMBERSHIP

Active			
Last report		1029	
Elected		199	
Restored		5	1233
Resigned		33	
Dead		11	
Dropped (delinquent)		39	83
			1150
Corporate			
Last report		70	
Elected		11	81
Associate			
Last report		123	
Elected		15	
Resigned	14	138	
Dropped (delinquent)	1	15	123
Honorary			
Last report (no changes)			7
Total membership			1361
Total last report			1229
Net gain			132

Mr. Dabney H. Maury: *Mr. President and Gentlemen:* There is no question of the fact that no year in the entire history of the Association can present so favorable a showing as is indicated by the reports just read. No formal action has as yet been taken on these reports.

On motion of Mr. Maury the reports were received and placed on file.

President Hill: The Association should feel doubly gratified and doubly indebted to the Finance Committee for the results of their careful scrutiny of all the expenditures, and for the work of the Treasurer in conserving the resources of the Association, and for the painstaking and careful work of the Secretary in eliminating all possible useless expense. The chair feels this from his intimate knowledge of the workings of the Association during the year; and takes this opportunity of expressing it publicly to the Association.

PUBLICATION COMMITTEE

Mr. President and Gentlemen:

The Publication Committee have no formal report to make. The results of the work of the Publication Committee are before you in the quarterly PROCEEDINGS.

There is no special subject to suggest to the Association other than that the committee have tried faithfully to carefully read over in advance all the papers presented, and to make such suggestions from time to time as to them seem to be to the advantage of the Society's publications.

During the year some question has arisen in the minds of the committee as to whether the formation of the new sections and the increased number of papers due to the section idea would not carry our printing beyond our means; but happily, the report of the Finance Committee, which you have all just heard, has shown that we are able to keep up with our increased program and increased number of papers; and the committee beg to congratulate the Association upon that result.

The committee also have to thank the Secretary for his faithful and efficient labors during the year in the detailed work of preparing the quarterly PROCEEDINGS.

JOHN W. ALVORD, *Chairman*
DABNEY H. MAURY,
EDWARD BARTOW,
H. E. KEELER.

ADDRESSES OF WELCOME

Hon. Milo R. Maltbie, Chamberlain of City of New York, Hon. John F. Galvin, member Board of Water Supply, and Hon. William Williams, Commissioner of Water Supply, Gas and Electricity, addressed the convention, welcoming the members to the city.

President Nicholas S. Hill, Jr., responded on behalf of the Association.

PRESIDENT'S ADDRESS

Members of the American Water Works Association, Our Associates and Guests:

I wish to acknowledge the honor you have conferred upon me in electing me President of this Association, with sincere gratitude. I

can truthfully say that I have striven earnestly to promote the welfare of the Association during the past year by stimulating interest and encouraging new membership. There is an old adage that there is nothing new under the sun, and I lay no claim to any startling innovation or unusual achievement, for I have no doubt that everything which has been done or suggested has been done before. My only claim is that I have endeavored to give a good account of my stewardship.

It may be well briefly to outline the present condition of the Association and to enumerate some of the more important happenings of the year.

Without wishing to encroach upon the reports of the Finance Committee or of the Treasurer, I desire to state that at the end of the fiscal year terminating April 1, 1915, the balance to the credit of this Association amounted to $4,283.60, and at the termination of the fiscal year ending April 1, 1916, this balance has increased to $7,115.06. For this excellent showing the Association is indebted to the careful scrutiny by our able Finance Committee and to the earnest endeavors of our worthy Secretary to curtail all possible expense.

For the purpose of stimulating increase of membership a cup has been offered to that section securing the largest proportionate accretion of membership during the year, and a badge will be presented to the member in each section reporting the largest number of new members secured individually.

In 1902 the membership of this Association was 346; at the end of the 1915 convention 1229, a gain of 883, or an average of 60 per year. Since the close of the 1915 Convention up to this morning the net gain in membership for the past year has been 103, or 43 more than the average gain for the past fourteen years, and there will probably be a still greater increase before the close of this Convention. While the results of this contest have not fully met my expectations, the gain has been a substantial one and probably greater than it would have been without the stimulus of competition.

The Four State Section, composed of Delaware, Southern New Jersey, Maryland and Eastern Pennsylvania, was inaugurated at a most successful lunch held at the Bellevue-Stratford Hotel in Philadelphia on January 8, 1916, at which over a hundred men were present.

A petition for the formation of a Canadian Section has been submitted to the Executive Committee and favorably acted upon, and

the outlook for the formation of a California Section is promising. Steps have already been taken to secure a petition from the Southwestern Water Works Association asking for incorporation as a section of this Association. An endeavor has also been made to interest members of this Association in the formation of a Southeastern Section comprising the South Atlantic and Eastern Gulf States.

It has come to be realized that much of the valuable experience and real knowledge which are requisite in intelligent city planning are found among the members of specialized organizations. The National Conference on City Planning has suggested the idea of bringing those bodies together whose field of endeavor touches on city planning, for the common purpose of contributing to the general knowledge of the subject. I have, therefore, added a Committee on City Planning to the list of special committees. Mr. Ernest P. Goodrich was prevailed upon to become a member of our Association and to accept the chairmanship of this committee in order that he might give us the benefit of his experience in this work and direct the initial steps of the committee along the proper lines of endeavor. I am convinced that this Association should take a definite interest in the broad question of city planning, and that all water works men should lend their aid to the movement for scientific city development and the correlation of city work, so as to secure not only the most economical but the most beautiful results.

During the year a committee, consisting of Messrs. D. D. Jackson, Alfred D. Flinn and E. E. Minor, has been appointed to represent the American Water Works Association in the Joint National Conference on Electrolysis, and we have also had representation on the Joint Committee for the Standard Classification of Technical Literature.

This Association has been represented during the year at the Pan American Conference in Washington, at the National Conference on Immigration and Americanization, and at the Conference on Standard Screen Scales held at the Bureau of Standards in Washington, D. C. At this latter conference, representatives of various engineering associations, as well as manufacturers of products in which the measurement of the fineness of the product enters, were present.

It has been my earnest endeavor to stimulate committee work generally, as I believe the chairmen of the various committees will testify. I trust they were neither offended nor harassed by my constant appeals for full committee reports at this Convention. I

wish to take this opportunity to express my appreciation of the kindly assistance and courteous support accorded me by all officers and committees of this body, and especially to our genial Secretary. I wish particularly to say a word of praise for the able and painstaking work of the Committee on Arrangements for this Convention and the handsome support given them by the representatives of the Water Works Manufacturers Association.

It may be well to dwell for a short space upon some of the needs of this Association.

At the present time there are 6000 water works in villages, towns and cities of the United States. Of this number but 500 are represented by active or corporate members in the American Water Works Association. In other words, but 8 per cent of the water works men of the country receive the benefits which may be derived from this Association. We will never exert the influence which we should until we reach a greater number of those interested in water supply matters. Our field of usefulness must be expanded if we are to take a proper place among the technical associations of this country. The formation of sections brings added financial responsibility, and in order to render proper service to our members our revenues must be increased. The only feasible method of increasing our revenues is by increased membership. Notwithstanding our opportunity to promote the general good of the water works fraternity, within and without our fold, and our evident financial needs, membership is not increasing as rapidly as it should. This is due to the apathy of the individual, and some means must be found to awaken consciousness of the responsibility which rests with each member to extend the good influences of the Association. It was with this object in view that the cup was offered, and it is hoped that it will add greater stimulus to the work of accretion during the coming year.

Equally as important as increase of membership is committee work. The committee work of an organization like ours is the measure of its usefulness. In no other way can we meet the needs of our members so well as by thorough investigations along special lines, followed by carefully considered reports thereon. Our sister association, the New England Water Works, has an enviable record of usefulness through its excellent committee reports. This is true of other technical societies in this country. The members of this Association who accept service on special committees must be made

to realize the responsibilities which they incur by their acceptance. With a few exceptions, the results of our committee work during the past few years have been almost negligible. The endeavor of our committees must be quickened.

It is true our committees suffer from two handicaps. The first of these is the wide separation of members and the difficulty of convening for conference and consultation. This widely scattered assignment of committee membership is, I believe, largely the outgrowth of the demand for distributing appointments to different sections of the country so as to preclude the possibility of predominance in a given section. If this consideration is to hold, then a better distribution would be to divide the committees as a whole among the various sections, so that the members of a given committee could meet with reasonable facility and without unnecessary cost in time and money. Sectional pride, as laudable as it may be, must not, however, be placed above the results to be achieved. An effort has been made to partially overcome this handicap by providing accommodations for the special committees during the Convention and by an attempt to interest the chairmen in calling their associates together during Convention week, but the drawback to our present system will never be overcome until the great body of our men realize that committee work to be effective must be carried through by those who are qualified and within reasonable reach of each other.

The second handicap to our present committee work is the absolute lack of funds for their purposes. It is not just to ask busy men to expend their time and energies on investigations and reports without compensation and expect them to go into their own pockets to pay the cost of such investigations as well. Now that the Association is established on a firmer financial basis, I know of no way in which its funds may be expended to better advantage than in appropriations to assist these committees to work out the problems allotted to them. I earnestly recommend that we hereafter provide funds for this purpose. These appropriations should be placed in the hands of the Finance Committee, to whom applicaton may be made for such funds as the committee chairmen may require.

Next in importance to our own committee work is participation with other associations and societies on joint committees. Coöperation between societies which have common interests to foster or differences to adjust can only be productive of good in the end.

The conferees learn better to appreciate the needs of each. The presence of a representative on such committees adds to the prestige of this Association. It is an outward indication that we are broad enough to look beyond our own borders and contribute to general progress.

The complete lack of coördination between our sections and the Association is a defect of our present organization. Under the present Constitution, the section chairmen are Honorary Vice-Presidents, but unless it happens that some section officer is at the same time a member of the Executive Committee there is no point of contact between the governing bodies of the sections and the parent Association. This is not conducive to harmony of purpose, nor to a proper appreciation of the general needs of the Association by the section officers. I do not presume to offer a remedy for this lack of coördination, but respectfully suggest that this matter should be taken under immediate advisement with a view to securing a remedy which will be satisfactory to the Association at large.

The growth of sections has materially added to the volume of matter published in the JOURNAL OF THE AMERICAN WATER WORKS ASSOCIATION. The publication of a bi-monthly in lieu of a quarterly journal has been suggested in order to provide for this growth, and I have no doubt that the desirability of a bi-monthly publication will be decided affirmatively. The increase in the number of issues of the JOURNAL will, however, bring a concomitant increase in the cost of publication. I can foresee that one of the most serious problems which the Association may have to face in the future will be the added cost of publications resulting from the formation of sections. One of our most urgent needs, therefore, is a careful scrutiny of all papers presented at the section meetings with a view to eliminating matter of doubtful value, needless repetition of similar topics, and long and wordy papers replete with superfluous detail. It would be truly hurtful to limit valuable matter contributed by the sections, but proper editing will accomplish the same result that the meter does in the average water works, namely, reduce waste without restricting needful use.

In this connection it may be suggested that the editing of a paper is no reflection upon the author. The engineer or the water works superintendent is not necessarily an experienced writer, nor is he always qualified to judge of the necessity for presenting a given topic to the Association. Proper editing will be helpful rather than

hurtful to the author, inasmuch as such editing will on the one hand enable him to convey valuable ideas more clearly to those whom he wishes to reach, and on the other hand, if his topic will not contribute to the sum total of useful knowledge, he will be saved the humiliation of presenting a useless paper.

The last suggestion brings the increasing demands upon the time of the Secretary-Editor forcibly to the front. Owing to the growth of the Association, the development of sections, the resulting expansion of the publications and the number of papers to be edited, the advisability of separating the office of secretary and editor must be seriously considered. It is doubtful if any one person can attend to the duties of both secretary and editor with a proper regard for each.

We have reached a stage where it would be well worth while to employ a trained editor for the purpose of securing the very best publication. This Association is largely judged by the character of the proceedings and the quality of the papers which it publishes. One man will be well and completely occupied if he spends the proper amount of time in seeking subjects for new papers which will be appropriate and useful, in finding the best authors for their presentation, in reviewing those papers which have been gratuitously offered, and in editing them and putting them in proper shape for publication. The editor should report directly to the Publication Committee so that the final selection of papers will not rest entirely with an individual. The Publication Committee should be appointed with a view to having the editor in close touch with his committee, so that all matters relating to publications may be efficiently and expeditiously handled.

The Secretary should be free to devote his time to the general correspondence of the Association, to attending meetings of the local sections and stimulating their activity, to the accretion of membership, to promoting committee work and the proper relationship between this Association and allied societies, to the arrangement for conventions, and the numerous other duties which devolve upon the executive officer of an association of this size. If proper consideration is given to other and more immediate demands upon our resources, our finances will not now admit of the establishment of permanent headquarters with a well paid, full time secretary, although we must never lose sight of this objective. It is quite impossible, therefore, for an individual, with other duties in addition to

the secretaryship, to give the proper time to the editorship, or if he gives proper time to the editorship to do full justice to the work of the Secretary. In making this suggestion, no reflection whatever is cast upon our earnest and faithful Secretary, but the suggestion is made rather to relieve him of some of the burden which he is willingly carrying and which is daily increasing in arduousness.

Having outlined a few of the more immediate problems now confronting us, I trust you will bear with me for a moment longer if I speak upon the broader aspects of the development of this Association. Several of the technical journals have recently come forward with editorials under such captions as "Can the American Water Works Association Find Itself?" and "What is Wrong with the American Water Works Association?"

The same queries may be directed to our schools, our churches and our courts. In former times you could make an effort to teach people what they needed to know. Men know the kind of problems their children would have to face, but today education means a radically different thing. We have to prepare our children to meet the unexpected, for their problems are not the same as their fathers'. To prepare them for the unexpected means to train them in method instead of filling them with facts and rules. They will have to find their own facts and make their own rules, and if the schools cannot impart that power they no longer educate.

The churches have come down to us with a tradition that the greatest things are permanent, and they meet a population that needs above all to understand the meaning of development and change. Ministers are as bewildered as the rest of us, perhaps a little more so, for they are expected to stand up every week and interpret human life in a way that will vitalize feeling and conduct. To ask the clergy to find adequate meaning in this era is to expect each minister to be an inspired thinker. If the churches could really interpret life, they would be unable to make room for the congregations.

The courts have not been able to adjust themselves to the present conditions with the result that our people fight the courts blindly without a clear notion of what they would like the courts to do. They are irritated and constrained by a legal system that was developed in a different civilization.

In the last thirty years or so our conditions have been passing through a reorganization so radical that we are just beginning to

grasp its meaning. President Wilson stated in one of his speeches:

> There is one great basic fact which underlies all the questions that are discussed on the political platform at the present time. That singular fact is that nothing is done in this country as it was done twenty years ago. We are in the presence of a new organization of society. We have changed our economic conditions absolutely, from top to bottom; and with our economic society, the organization of our life.

Through all this period of change we have become individually disorganized, for we have lost the ties which formerly bound us. In the very period when man most needs to concentrate on external affairs, he is disrupted internally by a revolution in the intimacies of his life. Even his sexual nature is chaotic through the immense change that has come into the relations of parent and child, husband and wife. These changes distract him so deeply that the more conscientious he is the more he flounders in the bogs of his own soul. Lack of certitude is the greatest burden of the day.

Is it surprising that we have not found ourselves amid the world-wide chaos of changing customs, ideals, morals and beliefs? Would it be well if we rested complacently in the belief that we had found ourselves? Is it not better never to find ourselves and to hold the illusive goal of perfection ever before us as an incentive to greater and better accomplishment? Our Association has not been unaffected by the spirit of change which is rampant everywhere. This Convention is fraught with the significance of change. I well remember the Convention of 1901 at the Murray Hill Hotel in this city. The meeting room was little larger than the room used for your Executive Committee at this Convention. This small room was not more than half filled by the attendance on the papers. The membership could be found in the café at any time of the day or night in a more or less stimulated state of exhilaration. The exhibits were insignificant and typical of that lack of the application of scientific study to water works details which was apparent for so long. The individual evidenced an almost complete absence of the sense of personal responsibility to the Association. Compare that with the present and we have a vivid picture of change in ideals and aspirations as well as of the progress which we have made towards finding ourselves. From a mere handful of men we have developed a regiment of soldiers. From an obscure, heterogeneous body we have produced a recognized, stable and respected Association. I think we are criticised too often for our past, and there is a

common tendency to misinterpret our present aims, to stress our externals and to overlook our true spirit.

But what is wrong with us? The failure of this Association is not more conspicuous than that of other organizations or societies, and springs from the same cause. It does not meet the individual need, and the individual is not called upon to do enough for it. Those familiar with the work of our engineering societies have agreed that the original aims of these organizations are not completely satisfying at present. It is not sufficient to organize, hold conventions, elect officers, read papers and publish proceedings. All of these things are necessary, but they are not adequate. The instruction of the individual is not sufficient. Something must be done to help him in a more material sense. If this is true of the strictly engineering societies, it is more so with regard to this Association. Broadly speaking, we are a technical society, but one of the chief aims of this Association is to benefit the superintendent. The greatest benefit which we can render to the superintendent is to assist him toward honest endeavor, efficiency and capability in his office; to stand behind the intelligent, sober and industrious water works man. Our greatest care should be that his badge is a certificate of character, responsibility, efficiency and power. The plan will naturally entail more difficulty than the present method of allowing every member to shift for himself. If, however, the individual felt the strength of the Association behind him he would be a better official to the everlasting benefit of the community he serves.

It has been stated in the articles referred to that the prospect of a junket is more alluring to the average member of this Association than the opportunity to add to his knowledge of the water works business. We are accused of being more interested in voting for the next place of holding a meeting than in anything else; that we resent the adoption of businesslike methods of electing officers because we fear that by the adoption of such methods we are losing some of our vested rights; that there is a strong tendency towards the formation of cliques and factions; that the operating men resent the active part taken in the management of the Association's affairs by technically trained men, and that there is an over-ambitious attempt at expansion.

I wish at this time to make public denial of some of these charges.

I do not believe it is true that the prospect of a junket is more alluring to the average member than is the opportunity to add to his

knowledge of the water works business. I know of no conventions where more earnestness is displayed, and where the business sessions are more generally and conscientiously attended than are those of this Association.

Nor do I believe that we are more interested in voting for the next place of meeting than in anything else. The session at which the next meeting place is selected is the only one which brings all classes of members together, and there is a natural rivalry between the friends of this place or that, which of itself portrays an excess of interest which is more apparent than real. There are certain features of this session which furnish a little variation to the humdrum round of technical papers and consequently there is a general relaxation on the part of all. In this connection, however, I do not believe that the function of the Committee on the Selection of the Next Place of Meeting, which has been in existence for the past few years, has been understood. It was not the idea that this committee should select a place of meeting, nor appropriate any of the functions of the voting membership, but that it should report its findings to the Convention so that it might make an intelligent choice between the invitations extended and not be governed solely by the spell binding efforts of some orator who is given the privilege of the floor. I believe that every member of this Association recognizes that the motives which should govern the selection of a meeting place are:

1. Consideration of the growth and development of the Association which will be brought about by the selection.
2. The educational benefit which will be derived from the selection.
3. The facilities which will be offered for the proper transaction of the business of the Convention and the comfort and happiness of those who attend.
4. Last and least, consideration of the amusement features which will be offered to those who attend.

The appointment of this committee was solely for the purpose of having representatives of the voting body calmly and judiciously to weigh the merits of the invitations offered, to crystallize the facts, and suggest which of the invitations most nearly fulfilled these requirements.

Neither do I feel that our members resent more business-like methods in choosing officers, but rather that there is an honest dread, which is inherent in every American, lest this Association become

undemocratic in its administration and that its powers be usurped by a few individuals who will use it for their own specific purposes. The entire discussion of the proposed change in method of electing officers at the Cincinnati Convention indicates this, and I, for one, do not feel that the democratic spirit is one which will in the long run work any injury to the Association. While there may be some who honestly believe that officers should be nominated on the floor of the Convention and chosen in the old-fashioned way, I believe that the majority appreciate that the business of an organization of 1500 men cannot be conducted in the same way that an organization of 300 would handle its affairs, and in order to expedite the work of the Convention it is necessary to delegate some of the powers of the individual to representatives chosen in a fair, open and democratic way. The mode of electing officers in 1890 is not adapted to the needs of 1916. To revert to the method of electing officers on the floor of the Convention will not in any way lessen political activity or the desire for selfish gains if such motives are present in our ranks.

I regret to say I must admit there is some justice in the charge that there is a tendency on the part of some to separate the membership into classes, which tends to the formation of cliques and factions, but in this we are no different from other organizations. It is, however, most unfortunate for this Association that the question of the profession or occupation of the member should be referred to in connection with his appointment for office. As I see it, this Association is composed of three coördinate branches:

The engineer and technical man.

The water works superintendent, who may or may not be a technically trained engineer, and

The manufacturer.

Of these, the first two form the active voting membership and are eligible as officers of the Association, and the third composes the associate membership. Each of these divisions is capable of performing a service for the Association. The engineer brings to the water works superintendent the result of his highly specialized experience. The water works superintendent gives to the engineer the benefit of his practical experience in the application of the technical advice of the engineer. The manufacturer demonstrates to both the latest development in those devices and appliances which are useful alike to the engineer and to the superintendent. There

is no reason for conflict more than there is reason for conflict between an army and navy enlisted in the common cause of defending their country. The three branches of this Association are coördinate. They should be coöperative and not antagonistic. The development of the narrow spirit which invokes antagonism between the three coördinate branches is a parasite which, unless immediately choked, will sap the very life blood of the parent upon which it preys. The future of this Association will be hampered if such a spirit continues.

Finally, I disagree with the statement that the complete nationalization of this Association is beyond the realms of possibility. I do not believe that we can be over-ambitious in our attempts at expansion. I should like to see every worthy water works man in the United States enrolled as a member of this Association. The only way in which the mass of those who are in charge of the smaller works in this country may be reached is through the formation of local sections. Sectionalization brings added burdens, I admit, but I believe that we should accept these burdens in the name of service, manfully shoulder them and solve the problems antecedent to complete nationalization.

The issue of a single, country wide association was raised by my predecessor, and everyone who has a disinterested regard for the welfare of the water works fraternity should weigh its merits and disadvantages carefully. There is much to be said in favor of a single Association. It would cut the cost and time required in attending conventions in half. It would lessen individual expenses for dues. It would minimize the cost of publications. It would facilitate the classification of our technical literature. It would reduce the demands upon the time of those who prepare technical papers. It would coördinate committee work and standardize specifications. It is fair to assume that one large national organization would wield a stronger influence in molding public opinion than would several smaller bodies. A national water works association has a great opportunity to direct public opinion in proper channels when legislatures are about to enact laws which vitally affect such matters as stream pollution, the powers of state boards of health, the purity of drinking water and the protection of water sheds. It could educate the public upon the necessity of placing costly water plants in the hands of skilled and qualified men without regard for the political affiliations. It could, as suggested, aid and abet worthy mem-

bers in resisting the influences which all municipal employees realize are at work to reduce the efficiency which they are striving to attain.

When a national association is mentioned, some say that its size will destroy the intimate personal relation which has been one of the most valuable assets of the smaller organizations. It is at this point that the sections become useful. It must be remembered that under our present system the larger organization is composed of smaller units, each holding its own meetings at regular intervals. These sections offer an adequate means for close contact among members and insure acquaintanceship for the member who attends the national convention.

Sooner or later the question of one national association must be definitely decided. There is ample time for thought in the interim, but provincial barriers and petty ambitions must be cast aside and the outcome must be founded upon a broadminded view of the whole situation considered alone from the viewpoint of the greatest good to the water works profession and from the standpoint of service to the country at large.

Preparedness is the order of the day, and we must be ready to meet the question of nationalization when it becomes an active issue, as it surely will. We will not find ourselves until we decide whether we are to be a great national organization or a narrow association developed through narrow consideration and a narrow attitude towards our fellow members. We must make this body as strong as its convictions. It matters little what our ideals may be and what achievements we may hope for if these ideals and achievements cannot be reduced to action. The events of the past and the events of the day show that ideals amount to nothing if we lack the power to maintain them against opposition.

It is pertinent to ask at this point: What should be the ideal of this Association? My answer is: Service. Service of the individual to the Association. Service by the Association to the individual and to the country at large.

What is needed primarily is individual service, as the corporate service of the Association is nothing more than the composite service of the individual. What we need, therefore, is servants, irrespective of calling or profession, servants who are willing to do and to help achieve the best results for the Association. Servants who are simple, honest men, with a fellowship of interest, an esprit de corps, and a decided discipline; men who are interested in the actual

work they are doing, for whom work itself is in a measure its own reward, in whom the instincts of workmanship, of control over brute things, the desire for order, the satisfaction of service rendered and uses created, and the civilizing passions are given a chance to temper the primal desire to have, to hold and to conquer.

REPORTS OF SPECIAL COMMITTEES

COMMITTEE ON REVISION OF STANDARD SPECIFICATIONS FOR CAST-IRON PIPE AND SPECIALS

Mr. President and Gentlemen:

The committee is not prepared at this time to submit a final report, but substantial progress has been made during this past year. It was realized when this committee went to work that if the specifications were to be revised it would be very desirable to have joint action with the New England Water Works Association; that is, if their specifications needed revision, as well as those of the American Water Works Association, it would be very fortunate if the two associations could agree on a common standard.

The matter was, therefore, taken up with the New England Water Works Association, and they appointed a committee also to act in the revision of such specifications. These two committees have worked together. Without going into details as to the work that they have accomplished, it might be stated that a joint committee has been formed, consisting of three members of the American Water Works Association's Committee, and three members of the New England Water Works Association's Committee. This joint committee has prepared a tentative draft of revised specifications, copies of which have been sent to the manufacturers of cast iron pipe in the United States, for their consideration. At a later date it is proposed to set a time for the manufacturers to meet with this joint committee and express their views on the tentative specifications that have been sent to them. After this meeting, and when the views of the manufacturers are better understood than they are at present, it is proposed to present a revised draft of the specifications to the membership of the two associations for their consideration.

There is one feature in connection with the work of this committee which should be brought up, and that is the question of funds. For the ordinary committee work practically only a small fund is

needed; but if it is necessary to revise the tables of dimensions and weights, it will be appreciated that a good deal of work will have to be done. The New England Water Works Association, when they appointed their committee, appreciated the fact that such work would require the expenditure of a certain amount of money, and they appropriated $500 for the use of their committee. No special fund is appropriated for the use of the Commitee of the American Water Works Association.

President Hill: We are very much indebted to Mr. Gregory for this very illuminating statement of conditions with regard to his committee's work, which does not adequately, however, convey to your minds the true amount of work which has been done this year by the members of that committee. They have had a very difficult situation to handle, and their work has involved a great deal of detail. The necessity of appropriations for committee work is well illustrated in the case of this particular committee.

On motion of Mr. Leonard Metcalf the committee was continued, and the matter of the appropriation of funds necessary to use was referred to the Finance Committee, with power to act.

COMMITTEE ON DEPRECIATION

Mr. Leonard Metcalf, *Chairman. Mr. President and Gentlemen:* The Committee on Depreciation is not prepared to make its final report at this time. Very careful consideration has been given to the subject of depreciation, and a detailed report has been prepared and is now in the hands of the committee and actively under consideration and discussion. Unfortunately, two members of the Committee are not here. One of them will be here later in the week.

It seemed wiser, in view of the apparent ambiguity in certain paragraphs of the report, or duplication of certain paragraphs, to give a little more time to the discussion of those paragraphs before presenting or attempting to present the report in its final shape to the association.

Mr. W. F. Wilcox: As a member of the Depreciation Committee, the speaker feels that some consideration should be given to the appreciation that the members of the Depreciation Committee feel of the laborious work that Mr. Metcalf has done on this subject.

The report covers twenty-five typewritten pages, which he has gotten up at the expense of a good deal of time and self-sacrifice for the benefit of the Association. The committee, as a whole, feels a deep regret that it could not agree with this report immediately and have it ready to present to the Association; but the committee felt that in justice to the committee as a whole, and in justice to the Association, it should carefully go over each one of the important points as viewed from different locations and different conditions, and attempt to get a harmonious report which would go on file and which would be a guide to the water works men in discussing and arriving at valuations as affected by depreciation.

On motion of Mr. H. E. Keeler, the committee was granted the additional time asked for in which to make its final report.

President Hill: This is another Committee Report that the Association can well look forward to with interest, and with a feeling of assurance that the membership generally will benefit by the results of the work that has been done.

STANDARD SPECIFICATIONS FOR HYDRANTS AND VALVES

Mr. B. C. Little, *Chairman:* Your Committee on Standard Specifications for Hydrants and Valves has held joint meetings with a similar committee of the New England Water Works Association, in an endeavor to agree upon a uniform standard for fire hydrants. The committee was also represented at the special meeting of the New England Water Works Association in Boston April 15, 1914, when the report of their committee was brought up for action by that Association. At that meeting the report of the committee, after some amendments and changes, was adopted, with the exception of three sections, which were referred back to the committee for further consideration and report. These sections referred to friction loss in hydrants; size of stem and hydrant nipples.

Your committee did not agree with the report of the New England Association Committee as to these three items, but has been unable to arrange a further conference with the New England Committee, though repeated efforts have been made to secure such a conference.

1. The allowance in the New England Committee's specifications for friction loss did not consider 4-inch hydrants, though hydrants of that size were retained on the list of standard hydrants in the report of the committee as adopted.

2. The report of the New England Committee did not permit nipples "locked and leaded" in place, providing only for threaded and screwed in nipples, except that nipples with lugs and bolted to hydrants were permitted.

3. The diameter of the operating stem was specifically stated and considered only the two general styles of hydrants, gate and compression or toggle. The sizes specified were considered by your committee as unnecessarily large for 4-inch hydrants. Your committee also considered that different patterns of hydrants would require different strength, and consequently size, of stem.

In all other respects your committee substantially agrees with the specifications of the New England Association, and has accordingly changed the specifications adopted by this Association June 24, 1913, so as to make them practically identical with those of the New England Association, so there will not be two sets of specifications.

The modified specifications for hydrants are submitted as follows:

Specifications for Hydrants

1. SIZE

Classification: The size of hydrant shall be designated by the nominal diameter of the valve opening, which must be at least 4 inches for hydrants having two $2\frac{1}{2}$ inch hose nozzles; 5 inches for hydrants having three $2\frac{1}{2}$-inch nozzles; and 6 inches for hydrants having four $2\frac{1}{2}$-inch nozzles; and shall be classed as one-way, two-way, three-way or four-way, etc., according to the number of $2\frac{1}{2}$-inch hose outlets for which they are designed.

Area of Water-Way: The net area of the hydrant at the smallest part, when the valve is wide open, must not be less than 120 per cent that of the valve opening.

Bell Ends or Flange Ends: All hydrants must be fitted with bell ends to fit standard cast-iron pipe, or if flanged they must be fitted with flanges of the standard dimensions corresponding to the pressure under which they are to be used; connecting pipe or flange from main to hydrant in no case to be less in diameter than the valve opening. (The standards referred to are those adopted or that may be adopted by this Association.)

2. GENERAL DESIGN

Type: Hydrants may be of compression or gate type.

Change in Diameter: Any change in diameter of the water passage through the hydrant must have easy curve, and all outlets must have rounded corners of good radius.

Water Hammer: Hydrants must be so designed, particularly as regards the pitch of the thread of the operating stem, that, when properly operated a water hammer will not be caused which will give an increased pressure to exceed the working pressure, when such pressure is over 60 pounds, nor increase the pressure more than 60 pounds when operated under less working pressure than 60 pounds.

Broken Hydrant: Valves when shut must remain reasonably tight when upper portion of barrel is broken off.

Friction Loss: With a 5-foot hydrant discharging 250 gallons per minute, through each $2\frac{1}{2}$-inch outlet, the total friction loss of the hydrant must not exceed 2 pounds for two-way, 3 pounds for three-way, and 4 pounds for four-way hydrants.

Strapping: When requested, hydrants must be fitted with 2 lugs, so that the leaded joint underground can be strapped.

Flange Joints above Ground: When hydrant barrel is made in two sections, the upper flange connection must be at least 2 inches above the ground line.

3. MATERIAL

Hydrant Body: The hydrant body must be made of cast iron.

Cast Iron: All castings shall be made from a superior quality of iron, remelted in cupola or air furnace, tough and even grain, and shall possess a tensile strength of 22,000 pounds per square inch. The casting must be clean and perfect, without blow or sand holes, or defects of any kind. No plugging or stopping of holes will be allowed.

Specimen Bars: Specimen bars of the metal used, each being 26 inches long, by 2 inches wide, and 1 inch thick, shall be made without charge, as often as the engineer may direct, and in default of definite instructions, the contractor shall make and test at least one bar from each heat or run of metal. The bars when placed flatwise upon supports 24 inches apart, and loaded in the center, shall support a load of 2200 pounds, and show a deflection of not less than 0.35 of

an inch, before breaking; or, if preferred, tensile bars shall be made which shall show a breaking point of not less than 22,000 pounds per square inch. Bars must be cast as nearly as possible to the dimensions without finishing, but corrections may be made by the engineer for variations in width and thickness, and the corrected result must conform to the above requirements.

Wrought Iron: All wrought iron shall be of the best quality of refined iron of a tensile strength of at least 45,000 pounds per square inch.

Composition Metals: All composition or other non-corrodible metals used to be of the best quality, to have a tensile strength of not less than 32,000 pounds per square inch, with a 5 per cent reduction of area at breaking point.

4. HOSE NIPPLES AND VALVES

Hose Nipples: Hose nipples must be of bronze or suitable non-corrodible metal, either threaded with a fine thread into the hydrants and securely pinned in place, or carefully locked and caulked in place.

Hose Threads: Hose threads on all hydrants to be installed in any given community must of necessity be interchangeable with those already in service, but, where practicable, threads should conform to the National Standard.

5. HYDRANT SEAT AND GATE

Seat: The seat must be made of bronze or suitable non-corrodible metal, securely fastened in place.

Valve: The valve must be faced with a yielding material, such as rubber or leather, except that, if of the gate type, a bronze ring may be used. The valve must be designed so that it can be easily removed for repairs without digging up the hydrant.

6. DRIP VALVE

Drip: A positively operating non-corrodible drip valve must be provided and arranged so as to properly drain the hydrant when the main valve is closed. The seat for the waste valve, which must be fastened in the hydrant securely, must be made of non-corrodible material. All other parts of the drip mechanism must be so designed as to be easily removed without digging up the hydrant.

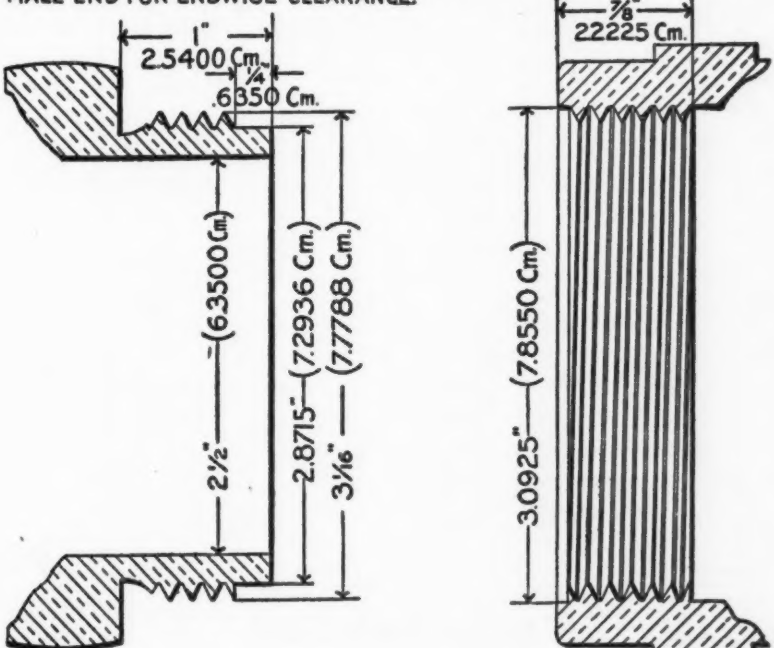
7. OPERATING PARTS

Operating Threads: The operating threads of the hydrant must be so arranged as to do away with the working of any iron or steel parts against iron or steel. Either the operating screw or the oper-

NATIONAL STANDARD HOSE COUPLING

	INCHES	CENTIMETERS
INSIDE DIAMETER OF HOSE COUPLING	2.5000	6.3500
BLANK END OF MALE PART	0.2500	0.6350
OUTSIDE DIAMETER OF THREAD FINISHED	3.0625	7.7788
DIAMETER OF ROOT OF THREAD	2.8715	7.2936
CLEARANCE BETWEEN MALE AND FEMALE THREADS	0.0300	0.0762
TOTAL LENGTH OF THREADED MALE END	1.0000	2.540C

NUMBER OF THREADS PER INCH.........7½
PATTERN OF THREAD.........60° V
CUT OFF AT TOP OF THREAD.........0.01 OF AN INCH
LEFT IN BOTTOM OF VALLEY.........0.01 OF AN INCH
FEMALE END TO BE CUT 0.125 OF AN INCH SHORTER THAN MALE END FOR ENDWISE CLEARANCE.



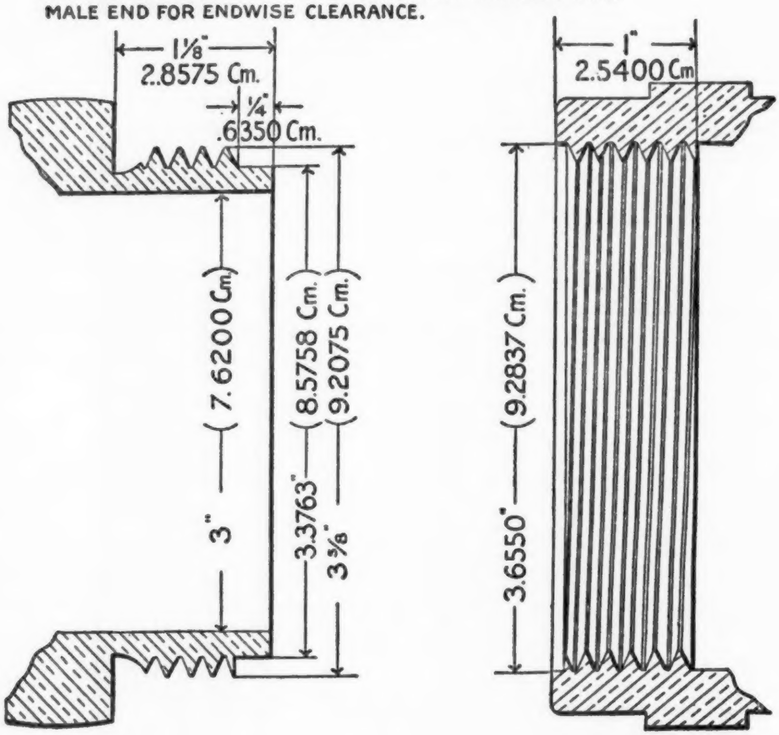
2½" SIZE (6.3500 Cm.)

ating nut must be made of non-corrodible metal, and sufficiently strong to perform the work for which intended.

NATIONAL STANDARD HOSE COUPLING

	INCHES	CENTIMETERS
INSIDE DIAMETER OF HOSE COUPLING	3.0000	7.6200
BLANK END OF MALE PART	0.2500	0.6350
OUTSIDE DIAMETER OF THREAD FINISHED	3.6250	9.2075
DIAMETER OF ROOT OF THREAD	3.3763	8.5758
CLEARANCE BETWEEN MALE AND FEMALE THREADS	0.0300	0.0762
TOTAL LENGTH OF THREADED MALE END	1.1250	2.8575

NUMBER OF THREADS PER INCH.........6
PATTERN OF THREAD.........................60° V
CUT OFF AT TOP OF THREAD..................0.01 OF AN INCH
LEFT IN BOTTOM OF VALLEY..................0.01 OF AN INCH
FEMALE END TO BE CUT 0.125 OF AN INCH SHORTER THAN MALE END FOR ENDWISE CLEARANCE.



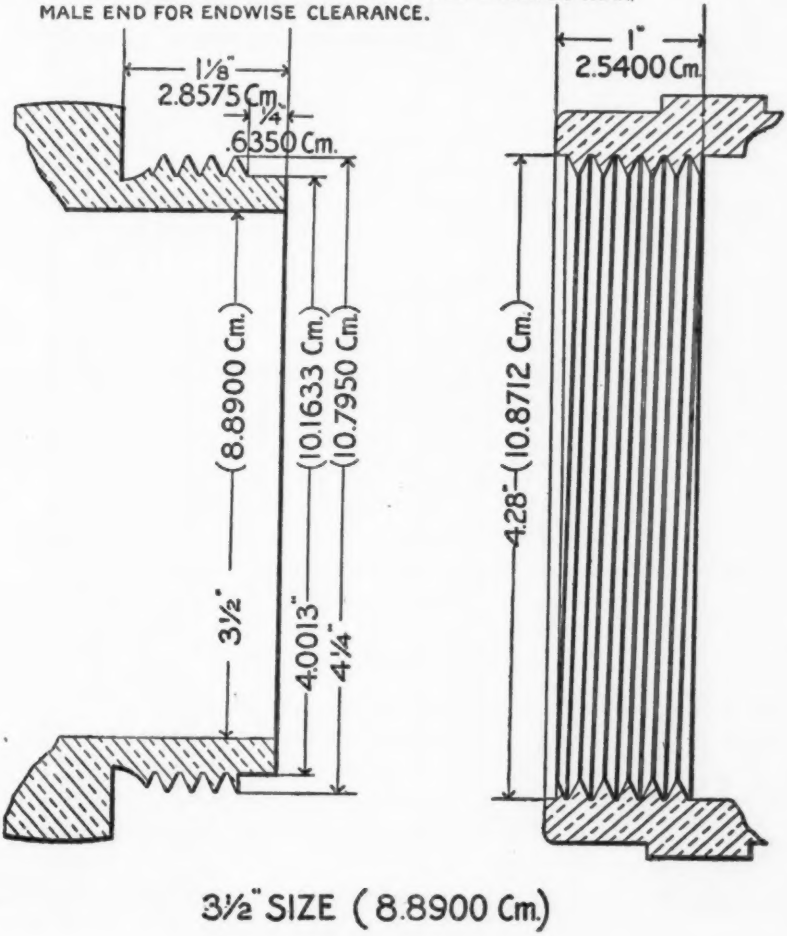
3" SIZE (7.6200 Cm.)

Top Nut: The stem must terminate at the top in a nut of pentagonal shape, finished with slight taper to 1½-inch from point to

NATIONAL STANDARD HOSE COUPLING

	INCHES	CENTIMETERS
INSIDE DIAMETER OF HOSE COUPLING	3.5000	8.8900
BLANK END OF MALE PART	0.2500	0.6350
OUTSIDE DIAMETER OF THREAD FINISHED	4.2500	10.7950
DIAMETER OF ROOT OF THREAD	4.0013	10.1633
CLEARANCE BETWEEN MALE AND FEMALE THREADS	0.0300	0.0762
TOTAL LENGTH OF THREADED MALE END	1.1250	2.8575

NUMBER OF THREADS PER INCH.........6
PATTERN OF THREAD.........................60° V
CUT OFF AT TOP OF THREAD.................0.01 OF AN INCH
LEFT IN BOTTOM OF VALLEY...............0.01 OF AN INCH
FEMALE END TO BE CUT 0.125 OF AN INCH SHORTER THAN MALE END FOR ENDWISE CLEARANCE.

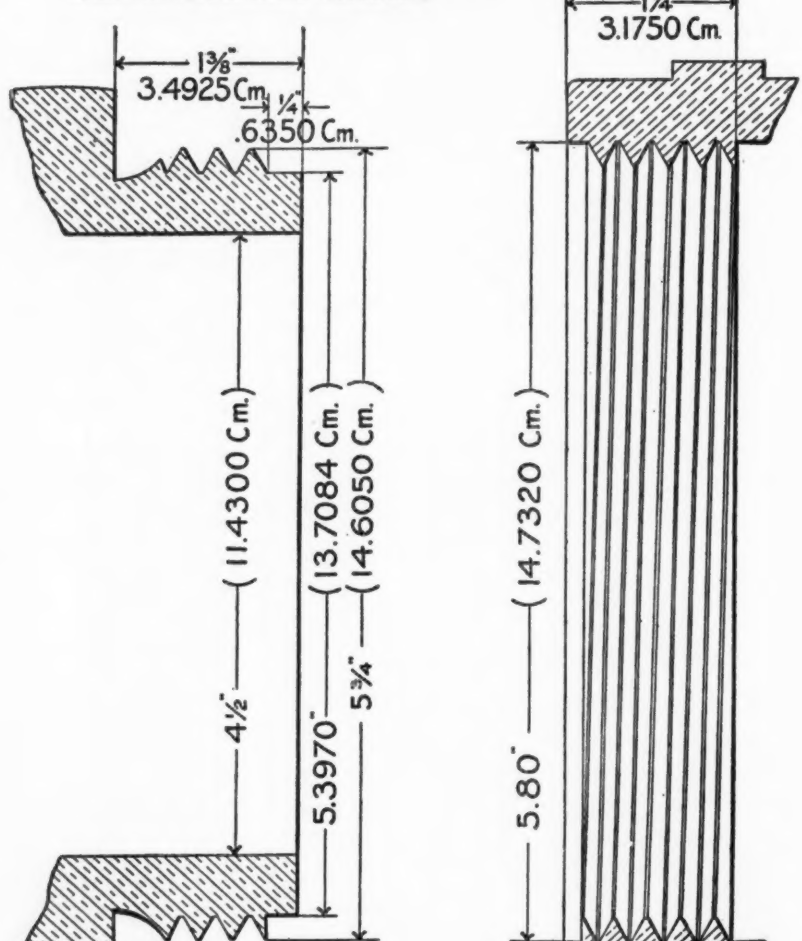


3½" SIZE (8.8900 Cm.)

NATIONAL STANDARD HOSE COUPLING

	INCHES	CENTIMETERS
INSIDE DIAMETER OF HOSE COUPLING	4.5000	11.4300
BLANK END OF MALE PART	0.2500	0.6350
OUTSIDE DIAMETER OF THREAD FINISHED	5.7500	14.6050
DIAMETER OF ROOT OF THREAD	5.3970	13.7084
CLEARANCE BETWEEN MALE AND FEMALE THREADS	0.0500	0.1270
TOTAL LENGTH OF THREADED MALE END	1.3750	3.4925

NUMBER OF THREADS PER INCH.........4
PATTERN OF THREAD.........................60° V
CUT OFF AT TOP OF THREAD..................0.01 OF AN INCH
LEFT IN BOTTOM OF VALLEY..................0.01 OF AN INCH
FEMALE END TO BE CUT 0.125 OF AN INCH SHORTER THAN MALE END FOR ENDWISE CLEARANCE.



4½" SIZE (11.4300 Cm.)

flat, except for hydrants to be installed where existing hydrants have different shape or size of nut, in which case the additional hydrants must have operating nuts similar to the old one for uniformity. The nut socket in the wrench must be made without taper, so as to be reversible.

8. STUFFING BOX AND GLAND

Stuffing Box: The stuffing box and gland must be of bronze or suitable non-corrodible metal, or bushed with bronze or suitable non-corrodible metal, when an iron or steel stem is used, or when an iron operating stem nut passes through the stuffing box. When packing nut is used, it must be made of bronze or suitable non-corrodible metal. The bottom of the box and end of the gland or packing nut must be slightly beveled.

Gland Bolts: Gland bolts or stubs must be at least $\frac{1}{2}$-inch in diameter. Bolts or studs may be either of bronze or suitable non-corrodible metal, iron or steel. The nuts must always be of bronze or suitable non-corrodible metal.

9. HYDRANT TOP

Top: The hydrant top must be designed so as to make the hydrant as weather proof as possible, and thus overcome the danger from water getting in and freezing around the stem. Provisions must be made for oiling, both for lubrication and to prevent corrosion. A reasonably tight fit should be made around the stems.

Lettering: There must be cast on top of the hydrant in characters raised $\frac{1}{8}$-inch, an arrow at least $2\frac{1}{2}$ inches long, and the word "open" in letters $\frac{1}{2}$ inch high and $\frac{1}{8}$ inch in relief, indicating direction to turn to open the hydrant.

10. HOSE CAP

Caps: Hose caps must be provided for all outlets, and must be securely chained to the barrel with a chain constructed of material not less than $\frac{1}{8}$ inch in diameter.

Cap Nut: The hose cap nut must be of the same size and shape as the top or operating nut.

Washer in Cap: When requested by the purchaser, a leather, rubber or lead washer must be provided in the hose cap, set in a groove to prevent its falling out when the cap is removed.

11. MARKINGS

Marking: The hydrant must be marked with the name or particular mark of the manufacturer. All letters and figures must be cast on the hydrant barrel above the ground line.

12. TESTING

Testing: Hydrants for pressures of 150 pounds or less, after being assembled, shall be tested by hydraulic pressure to 300 pounds per square inch, before leaving the factory. If the working pressure is over 150 pounds per square inch the hydrants must be tested to twice the working pressure. The test must be made with the valve open in order to test the whole barrel for porosity, and strength of hydrant body. A second test must be made with valve shut, in order to test the strength and tightness of the valve.

13. DIRECTIONS TO OPEN

Opening: Hydrants must open to the left (counter clockwise) except those to be installed where existing hydrants open to the right, in which case the additional hydrants must turn the same as the old ones for the sake of uniformity.

Your committee has not been able to decide upon specifications for light valves, for use in connection with filter plants, etc. But believes that such specifications should be established, to protect purchasers from the makers of valves much too light and flimsy in construction for even such light pressure. While valves in filter construction usually work under very light pressure, they are more frequently used than line valves and should be so constructed as to withstand such frequent use. For the present we resubmit the valve specifications adopted in 1913.

B. C. LITTLE, *Chairman.*
MORRIS R. SHERRERD,
JAMES H. CALDWELL,
DENNIS F. O'BRIEN,
CHARLES R. WOOD,
W. R. CONARD,
J. M. DIVEN.

B. C. Little, *Chairman:* We would like to have this put in as a final report for hydrant specifications.

On motion of Mr. H. E. Keeler the report was accepted, and the specifications adopted and ordered printed in the Journal.

On motion of Secretary Diven the Secretary was authorized to have 2000 separate copies printed, one copy to be sent to each member of the Association, the remaining copies to be held for future distribution or for sale.

COMMITTEE ON WATER CONSUMPTION

Your Water Consumption Committee presents herewith its report for 1915–1916 and considers that this report should be designated as a progress report.

Careful consideration was given as to the advisability of attempting to obtain further information along the general lines followed in the 1914–1915 report, but it was concluded that the digesting of data previously obtained and the consideration of water consumption forms for annual reports would be a more useful work.

The data previously given have been grouped in tabular form by listing all communities reporting in order of consumption per capita, beginning at the lowest recorded and placing the statistics under the following headings:

- City
- Population
- Per cent taps metered
- Per cent water metered
- Water unaccounted for
- Total per capita consumption
  - Geographical group
    - Eastern—Middle West—Western
  - Climatical group
    - Severe winter—Moderate winter—No winter
  - Per cent of water metered (4 divisions)
  - Per cent of taps metered (4 divisions)
  - According to population (3 divisions).
- Domestic per capita consumption
  - Per cent of taps metered (4 divisions)

This grouping brings out clearly the variation of communities in consumption per capita under what may be similar conditions and further emphasizes the necessity of an intensive study of water consumption and allied statistics to permit intelligent use of data given by the cities, towns and villages. The previous experience of this committee, as well as that of water works engineers and superintendents, shows that the existing form for reporting water consumption as adopted by the American Water Works Association should be revised. An examination of the records revealed that the present form is essentially the same as that adopted by the New England Water Works Association in 1886, which was as follows:

1. Estimated total population.
2. Estimated population on line of pipe.
3. Estimated population supplied at date.
4. Total number of gallons consumed for the year.
5. Passed through domestic meters.
6. Passed through manufacturing meters.
7. Average daily consumption in gallons.
8. Gallons per day to each inhabitant.
9. Gallons per day to each consumer.
10. Gallons per day to each tap.

The New England Water Works Association reported on uniform statistics for water works in 1902, and then recommended the form adopted in 1886 with the combination of lines 5 and 6 into one reading "Passed through meters" and the adding of the line "Percentage of consumption metered."

In 1908 a committee of the American Water Works Association reported recommending the form adopted by the New England Water Works Association in 1902 and adding two lines relating to the cost of water. The American Water Works Association has not changed its form since 1908, although the New England Water Works Association had presented to it in 1913 in a very comprehensive report of its Committee on Water Consumption, Statistics and Records, Leonard Metcalf, Chairman, a revised and enlarged form which much more adequately deals with consumption of water. One form should be used by the two associations and prompt action on this important matter is most desirable. As a step towards obtaining such action, your committee recommends that this Association continue a water consumption committee and request the New Eng-

land Water Works Association to authorize a suitable committee of that Association to confer on what changes, if any, should be made in the New England form as a result of further experience, before a form is adopted jointly by both associations.

Respectfully submitted,

EDWARD S. COLE, *Chairman*,
J. N. CHESTER,
W. S. CRAMER,
WILLIAM W. BRUSH,
JOHN H. DUNLAP.

MR. J. N. CHESTER: The work of this committee has been and is very difficult, as probably some of the members of the similar committee of the New England Water Works Association will appreciate; all the members of the different Associations are being imposed upon by the flood of inquiries for information. The work of the committee this year has been largely looking toward the amalgamating of the work of the American Water Works Association and the New England Water Works Association. One matter that was left out of the report, and in which the speaker has been most interested, is securing some early results on what perhaps is the ultimate and most valuable part, namely, what percentage of water we cannot account for at all. Now, there have been two instances since our last meeting where a good tabulation of results of that kind would have been worth several thousand dollars to the two different corporations involved. Whether municipal or private plants, it seems to be one of the hardest things and the least touched upon in published statistics. Commissions are now forcing companies and corporations to spend all the way from $5000 to $20,000 analyzing their situations looking to the fixing of water rates; and you come to this question and state the facts as you know them, to wit, that 40 per cent of the water is unaccounted for. You may explain that you have a master-meter measuring the water to your distribution system, that you have every connection on that distribution system metered, that the metered consumption totals, we will say, in the neighborhood of 60 per cent of the registration of the master-meter, and the commission will sit and look aghast at you when you make that statement. When you turn to the records and annals of our different Associations you can find very little in them to substantiate such a statement, and yet the crux of the condition finally de-

pends upon that very thing. We have nothing to go to; and you can see that this Water Consumption Committee has some work to do that should be done quickly.

This committee needs to have some help in gathering material during the next year. It does not want to go through a long effort toward harmonizing the two associations, because if the committees of the two Associations have as hard a time getting together as some of the other committees of these two Associations have had it will be two years more before results are obtained.

On motion, the report of the Committee on Water Consumption was received, ordered printed and the committee continued.

STANDARD FITTINGS FOR WATER METERS

At the last meeting of the Association held at Cincinnati, your committee made a verbal report that it hoped to have a complete recommendation prepared and submitted at this meeting. Since that time, several new members have been added to the committee, and among others a representative of the manufacturers. He has conferred with the majority of the largest manufacturers of water meters, and while they take no exception as a compromise to the lengths as recommended at the Philadelphia meeting, he states that he is unable to make further progress at this time. This is not because of any lack of disposition to coöperate, but simply beyond the first three sizes the difference in shape and model makes the adoption of a uniform length exceedingly difficult.

Your committee believes that, while the work will be a long one, in the end the results will be satisfactory; therefore this committee recommends that the lengths as suggested by this committee at Philadelphia be promulgated by the American Water Works Association as standard, which lengths were as follows:

⅝ inch	7½ inch	2 inch	15¼ inch
¾ inch	9 inch	3 inch	24 inch
1 inch	10¾ inch	4 inch	29 inch
1½ inch	12⅝ inch	6 inch	36 inch

Your committee believes that it is possible to establish standard connections based on the lengths as herein reported, which will be acceptable to the manufacturers, but this cannot at this time be done as a whole, but that an effort should be made to establish standard

connections for $\frac{5}{8}$ inch, $\frac{3}{4}$ inch and 1 inch which will meet with the approval of the manufacturers.

When this has been accomplished, then it will be possible to take up the $1\frac{1}{2}$ inch and 2 inch sizes, and later probably to reach the larger sizes.

Respectfully submitted,

Chester R. McFarland, *Chairman.*

June 8, 1916.

Mr. Chester R. McFarland: In talking with the member of our committee who represented the manufacturers he says that they do not want this standard put forth as the standard of the manufacturers, but as a standard promulgated by this Association.

Our idea in connection with this report is that there should be prepared connections for $\frac{5}{8}$ and $\frac{3}{4}$-inch meters giving the length of the tail piece, the threads per inch, the size of the union coupling, and the number of threads to the inch. Those sizes are now so nearly uniform that we believe that if this was prepared to as nearly a uniform standard as now exists we could get the manufacturers to accept it; we find in comparing these threads that there is but a slight difference in threads and in many cases you can force them on.

Our committee has been scattered from the south coast of Florida to the Great Lakes, and we have found it impossible to get together except at these meetings. Usually we get together after the convention has been in session two or three days, and it is possible that this work could be better prosecuted if this Association would appoint a committee the members of which would be close together and nearer the center of manufacture.

The manufacturers have shown a disposition to do everything they can; and they are today feeling that they would be glad to coöperate, that is, if we could arrive at some standard.

President Hill: You have heard the report of this committee. What is your pleasure, gentlemen, to accept the report and file it and leave it to the incoming President to act on Mr. McFarland's suggestion for the appointment of a new committee, or to make a motion embodying your instructions with regard to the appointment of a committee?

Mr. Bernard M. Wagner: Would it not be possible for each section to have a committee on this subject and then have the results of their deliberations reported at the next Convention? That might be the best way, if you want to get your committees together; for instance, appoint a committee for your New York section and a committee for each of the other sections, and let each section take up the subject in its own way. Some sections will probably take it up from the manufacturer's standpoint, whereas others may take it up entirely from the user's standpoint.

President Hill: That suggestion would probably be taken under careful advisement by Mr. Metcalf.

On motion of Mr. Bernard M. Wagner the committee's report was accepted and the matter of a new committee referred to the incoming President.

PLUMBING CODE AND CONTROL OF PLUMBERS

In taking up the subject of control over the installation of private plumbing this committee has naturally confined itself to the water works viewpoint. It is now generally accepted that adequate supervision of plumbing as regards all sanitary features should be vested in the public health authorities. This will undoubtedly continue to be the general practice except perhaps in a few communities where the health department is poorly organized. From the water works viewpoint, no questions of health are involved.

There are two important reasons, however, which compel the interest of the water department in the private plumbing. The first is the necessity of preventing undue waste of water. The second is the desirability of promoting general and individual satisfaction with the water service.

It is well known that by far the greatest waste of water on almost all systems occurs from defective service lines, house plumbing and leaky fixtures. This can be largely reduced by the use of meters, although even in this case, it is necessary that the service lines be laid by the water department or else that it have suitable control over the plumbers installing them. In the case of the many systems where meters are not used for one reason or another it becomes almost imperative that the water authorities have control over the materials and workmanship entering into private plumbing.

The city of New York through its highly efficient officers and engineers has developed the greatest water works system in the world of ancient or modern times, furnishing an abundant supply of water to its population of 5,600,000 citizens.

The daily consumption in Greater New York is 545,000,000 gallons, for which an annual revenue is collected from frontage and metered accounts amounting to $13,000,000.

2750 officers and employees are required to perform the regular work of the Department of Water Supply.

Mileage of mains	2643 miles
Valves in the distributing system	60,700
Fire hydrants	43,300
Mileage of streets	2643 miles
Range of elevation zero to	426 feet
Cash value of existing system	$227,000,000
Total number of services	377,349
Total number of meters in use	101,068
Total number of unmetered services	276,281
Percentage of services metered	26 per cent

We give the above data for the value of the information it contains and to show that a comparatively small percentage of services are metered in the world's greatest water works and we are forced to deal with the problem as it exists.

It often occurs that the water consumers' yearly plumbing repair bills exceed the annual charge for an abundant supply of pure and wholesome water. The street service line may be laid at the proper depth according to local climatic conditions. No trouble may exist inside the dwelling or building. The service is interrupted. The water department is requested to investigate, and finds the supply pipe frozen from the curb line into the premises, due to insufficient depth of trench when installed by the plumber. The water department has been put to the needless expense of an investigation. The consumer is required to expend from $5 to $10 to restore water service. The cost of the water service to patrons is represented by the aggregate of all items properly chargeable to it, and an intelligent public has begun to look upon it in that way.

The circumstance that water works operators are not obliged to carry these suggestions too far cannot blind even the most indifferent officer to the fact that upon the water works none the less devolves the responsibility and the burden.

The increased cost of one kind of house supply pipe over another applies to the material only as it costs the same to transport, fabricate and install.

The average dwelling requires about 100 feet of pipe for complete hot and cold water service. The difference, then, in the cost of using one grade of pipe over another is reflected in the price of the 100 feet of pipe.

It may be urged that the water department is hardly concerned with the promotion of general and individual satisfaction with the water service to the extent of supervising private plumbing. It should be recognized, however, that the water supply may be excellent as regards quality, quantity and pressure in the mains and yet as a result of improper plumbing be extremely unsatisfactory as drawn by the consumer.

The whole broad tendency of modern public service is to extend that service just as far as possible with advantage to the consumer. The consumer should have the benefit of the knowledge and experience of the water works officers in all ways that will operate to improve his individual service.

Furthermore, it should not be lost sight of that the greater the satisfaction of the consumers as a whole with the water service, the more readily is the necessary popular support obtained for the water department.

There are many ways that the knowledge and experience of the water department may be made of value to the consumer, whether by embodying the results in a plumbing code with proper supervision of plumbers or by systematically imparting the information to the consumers and local plumbers in an informal manner.

As a result of its experience and familiarity with the chemical nature of the water it can determine the best material for piping having regard to length of life, corrosion, red water troubles, safety under pressures involved and cost of maintenance.

The best arrangement of piping can be suggested, looking to protection against leakage and frost, elimination of vibration and noise, accessibility and provision for convenient drainage.

CONCLUSIONS

As a result of its consideration of the subject your committee desires to submit the following conclusions:

1. It would in most cases prove of benefit to have the water department coöperate with the other authorities, notably the health department, in the preparation of the plumbing code, and in the examining and licensing of plumbers.

2. Where the meter system is not in use it is imperative that the water department have control of the private plumbing installed as regards all supply piping and fixtures connected thereto, including service lines. Such control to include the specifications of materials and workmanship involved by means of the plumbing code or other suitable set of rules, the licensing of plumbers and the inspection of the work.

3. Where meters are in use, the water department should have entire control of all service lines up to the location of the meter.

4. The water department in all cases should endeavor to furnish its consumers with as much helpful information as possible with regard to the best materials and workmanship adapted to local conditions and all other suggestions tending towards minimizing the troubles arising from private plumbing from any cause.

Respectfully,
SCOTLAND G. HIGHLAND, *Chairman.*
JAMES R. MCCLINTOCK,
WILLIAM I. KLEIN,
WILLIAM MCCARTHY,
Committee.

DISCUSSION

MR. THEODORE A. LEISEN: It would be highly inadvisable for this Association to go on record as recommending that water departments take over the control of all the plumbing throughout the house. The speaker's feeling is that that is going further than would be found advisable in general practice. He would hesitate on that account to vote to recommend the adoption of the report as representing the views of the Association.

MR. C. B. SALMON: *Mr. President and Gentlemen*: What Mr. Leisen has said has a backing in the experience of the electrical business. Most of the electrical companies today, that is the private companies, have ceased to do house electrical wiring, or house repairs of any kind, for the reason that so many people ring up the

phone and want little things done that they do not wish to pay for. If you take over all this house inside plumbing you are going to have the same trouble, and your telephones will be ringing constantly because some faucet is leaking and cannot be shut off, and they want you to send a man right up; and then because it is such a little matter they do not want to pay for the service. The speaker would not like to vote to assume the responsibility of any kind of plumbing inside of the house. There may be some justice and some reason for having the control of the service pipe up to and including the meter, and it has been advocated that the utility ownership should include both the service line to the curb and into the house; the labor and maintenance of the meter being guaranteed by the property owner when he signs the application to put in the service. If you include inside plumbing you are going to have to do a lot of work for nothing, or else incur a lot of blame in charging for it.

Mr. M. N. Baker: At the beginning of the report the statement is made that "It is now generally accepted that adequate supervision of plumbing as regards all sanitary features should be vested in the public health authorities." It may be that the majority of opinion is that way; but the more progressive opinion, both as regards health and as regards the broader problem of municipal administration, is against having the Health Board in control of plumbing. The speaker's own experience and observation is, that plumbing should be in charge of the Building Department.

All see the evil effects of the multiplication of inspection. It is now conceded pretty generally by those who are posted on the subject that plumbing has comparatively little relation to health. It is highly desirable, from a health standpoint, that those matters which have little relation to health should be taken away from the Health Department, and put where they can be handled to better advantage.

It is very troublesome to every one who has to do with building operations to have to go to the Health Department, and various other departments, before they can get the permits and the inspection that is required before a new house can be built and occupied or before repairs to an old one can be made. The speaker would, therefore, dislike to see this report adopted in so far as it carries approval of the idea that the plumbing should always be in charge of the Health Department. If, as has been suggested, the Water

Department also is to exercise control, these inspections are multiplied, which is certainly very undesirable.

Mr. J. N. Chester: The speaker did not hear all of the discussion of the report, but heard what Mr. Salmon said, and can put his O. K. on same and add his weight to the arguments that were advanced. He feels just as Mr. Salmon expressed himself in regard to this question, that water departments and water companies do not want to become mixed up with the plumbing, at least beyond the meter. He foresees the difficulties that his experience indicates will be met with. Imagine the conflict with the labor unions; the rules and regulations that would soon be imposed upon you would force you out of business.

President Hill: There is one aspect of plumbing supervision which has not been referred to specifically in this discussion. Many, if not most, of the complaints of lack of pressure attributed to deficiency of mains are really due to deficiencies in the design of the house plumbing. All know that the object to be sought from the public corporations' viewpoint is the elimination of friction with the consumer. The majority of complaints and disagreements which arise between the public utility and the public at large are not the result of unjust rates so much as they are of lack of service, and whereas a city water department may be immune to rate adjustments as a result of poor service, these departments should give the best service possible because the primary motive in establishing them was the desire on the part of the public to get good service. Service conditions will never be satisfactory unless there is some civic agency through which a proper and careful specification for plumbing is devised, a specification which requires a given size of pipe to supply a given number of openings. That is the line on which the speaker had hoped this committee would work with a view to establishing the relationship between size of pipe and the number of openings, so that when a builder designed a building he would have a definite basis on which to design his plumbing system and would not be required to use the haphazard methods which are now in vogue.

Perhaps this function should not be assumed by the water department, but the water department in coöperation with the building department, and if necessary the Health Department, should

formulate such a set of rules, and where could this work be initiated to better advantage than in this Association?

On motion of Mr. J. N. Chester the report of the Committee on Standard Plumbing Code and Control of Plumbers was referred back with the request that it be carried further and revised in accordance with the suggestions brought out in the discussion.

PRESIDENT HILL: Now we have another matter before us, the letter of the Clarksburg Water Works and Sewerage Board, contributing \$25 annually toward furthering the interests of this Association. The Chair should like to know what disposition to make of that matter?

The letter was read, as follows:

As a signal mark of appreciation of the splendid work accomplished by the American Water Works Association, through its highly efficient officers and the personnel of its membership throughout the country, the Clarksburg, West Virginia, Water Works and Sewerage Board has ordered that the sum of \$25 be contributed annually toward furthering the interest of the association.

We have been benefited by the proceedings of the association and have received valuable courtesies through many distinguished members of the association of very great assistance in the operation of the department.

Very respectfully,

SCOTLAND G. HIGHLAND,
Secretary and General Superintendent.

On motion of Mr. Dow R. Gwinn, the contribution was accepted with the thanks of the Association.

MECHANICAL ANALYSIS OF SAND

MR. GEORGE W. FULLER: Mr. Burgess is not here. The committee would like to report progress. This is a pretty complicated problem. There are many ramifications, and we desire to proceed slowly. We have taken up the matter with the Bureau of Standards in Washington, and if agreeable, we would be glad to be given the opportunity to proceed with this complicated matter somewhat further.

MR. EDGAR M. HOOPES, JR.: With regard to the work of the Committee on Mechanical Analysis of Sand, the American Water Works Association was represented at a conference held at the Bureau of Standards in Washington, on April 30th, last.

At the conference there were present representatives of practically every industry in which fineness tests are required.

After considerable discussion of the feasibility of establishing a standard screen scale, two proposed standard scales, prepared by the Bureau of Standards, were considered.

The result of this action was that the conference expressed its preference for the adoption of a standard screen scale based on the metric system and having the 1 mm. opening as a unit, together with such slight modifications as might be found desirable after consultation with manufacturers and users of sieves. This action was taken as against screen scales based on Tyler series and the so-called English series, proposed by the Bureau.

The conference further expressed its preference in the matter of a standard scale by voting that the standardization and rating of any scale in the series should be in accordance with the actual size of the opening instead of the size of separation or mesh number.

In addition a subcommittee of five was appointed by the Bureau of Standards to carefully consider the details of the metric series, paying special attention to wire diameters, tolerances and important questions of manufacture, and to report back at some convenient time to the Bureau of Standards.

Your committee has felt that it would be unwise at this time to present a written report of its findings in the matter until the final results of the Bureau of Standards are made available.

We wish to state, however, that the matter of a standard screen scale is progressing rapidly toward a definite solution, and probably within the next year we will have such a standard which will be employed by all industries using a fineness test. The present confusion existing in this matter will thus be remedied.

Mr. George W. Fuller: Assuming that the Bureau of Standards does effect an agreement among all those interested in sizing sands, then from the viewpoint of the water works interests, and more particularly of those engaged in sizing sands for filter beds, the development of the last twenty-five years should be translated in terms of the new ratings so that there will not be an abrupt break in the records, and it would be well for this committee to be instructed as to the scope and purpose of its work. The speaker is not sure in his own mind as to just what the scope is; and would like to have that brought clearly to the attention of the Association.

Mr. Paul Hansen: The speaker happened to be present at the discussion of Mr. Burgess's paper, and his recollection is that what Mr. Fuller referred to is very clearly within the scope of this committee.

Mr. George W. Fuller: The work of our committee in a certain sense has to await the decision of the Bureau of Standards, which is to take into account a scheme of sieving sands so that it will meet with the views of those interested in all lines of work. It is impossible to say how long a delay that may mean.

President Hill: We do not wish to curtail the scope of the work of this committee. It should be largely a matter of judgment on the committee's part as to how far it goes and how soon it will make a final report. This is a question that we would like to get definitely settled in some way; and if time is to be gained in the long run by delaying present action, it might be better to do so.

Mr. Leonard Metcalf moved that the committee be continued and that it be the sense of the Association that the scope of the work of this committee should include the line of inquiry suggested by Mr. Fuller.

The motion carried, and so ordered.

Mr. Edgar M. Hoopes, Jr.: Before leaving this question there is one other point that should be brought to the attention of all, and that is that the Bureau of Standards is looking into the objections, from a manufacturing standpoint, to constructing this screen scale founded upon absolutely scientific principles. The ratio of the wires and the actual size of the opening is one that should be standardized; and it is a question whether it will be necessary to have wires specially drawn, that is one of the questions that will come up, and one of the reasons why there will be a slight delay; but it is very important work, and one that we can well afford to await the proper settlement of.

COMMITTEE ON ELECTROLYSIS

To the President and Members of the American Water Works Association:

Your Committee on Electrolysis begs leave to submit the following report:

Your Association has affiliated itself during the past year with the Joint National Committee on Electrolysis and appointed three members on this joint committee. In view of the fact that the Joint National Committee has in preparation a preliminary report reviewing the status of the electrolysis situation, your committee will confine its report to the following brief statements of fact and of the stand which it believes this Association may properly take:

1. An increasing amount of damage from stray electric currents is occurring on the underground water piping systems in many localities throughout the country where adequate measures have not been taken to reduce this damage.

2. The principal and generally the sole source of stray electric currents causing this damage is the single-trolley direct-current electric railways employing the running tracks in contact with earth as part of the return circuit.

3. Inasmuch as such electric railways are the chief and generally the sole sources of stray currents causing the damage, and as the owners of such railways have no right to so operate their railway system as to cause serious damage to the property of others, it is the duty of the owners of these railways to provide measures for reducing this trouble by removing its cause as far as this is practicable.

4. Experience extending over many years in foreign countries and over ten years in this country has shown that methods which are practicable and economical can be applied to electric railway systems which will remove acute dangers from stray currents and which will very greatly reduce the danger in all cases where bad electrolysis conditions exist, and in most cases will reduce this danger to negligible amounts.

5. Your committee finds that mitigating methods applied to underground water pipes fail to attack the real cause of the trouble, and when used as the sole mitigating means fail to give adequate and permanent relief. Your committee further believes that mitigating methods should be applied to underground pipes, if at all, only in special cases and only after adequate methods of minimizing the production of stray currents have been applied to the railway system.

6. Your committee disapproves as not only inadequate but frequently also as dangerous such metallic connections from underground water pipes to the railway return circuit as cause these pipes to become a substantial part of the railway return circuit. Such

connections greatly increase current flow on pipes, and while they may afford local protection they generally distribute electrolysis troubles to other localities where these are more difficult to find, and thus frequently give a false impression of immunity. Your committee therefore believes that metallic connections from water pipes to the railway return circuit should never be applied as the principal means for electrolysis mitigation.

7. Your committee believes in view of the fact that the railway companies in common with the pipe-owning companies are public utilities operating under public franchises and utilizing city streets, that it is the duty of both of these utilities to coöperate in order that the causes and extent of any danger from stray current can be more readily ascertained and the problem can be attacked along broad engineering lines.

Respectfully submitted,

Albert F. Ganz, *Chairman.*
Charles R. Henderson,
Daniel D. Jackson,
Robert H. Jackson,
Edward E. Minor,
Committee on Electrolysis.

New York City, June 7, 1916.

After presenting the foregoing report Professor Ganz remarked as follows:

Gentlemen, your President has asked for a few words in explanation of the report. The Joint National Committee was formed three years ago and has now the following membership: The American Water Works Association, three representatives; the American Gas Institute, three members; the Natural Gas Association, three members, (You see, therefore, that there are nine representatives from these three strongest national pipe-owning companies in the country represented on that committee); the American Telephone and Telegraph Company, three representatives; the National Electric Light Association, three representatives; that makes six representatives of the largest lead cable-owning concerns in the country, and their interests run with the interests of the pipe-owning companies because they are often more subject to attacks of electrolysis from stray currents than are the owners of pipes.

There are two railway associations represented, the American Electric Railway Association, and the American Railway Engineering Association, each by three representatives, making a total of six. Then there are three representatives of the American Institute of Electrical Engineers, which is fairly considered a neutral body, and one representative from the Bureau of Standards, Doctor Rosé, Chief Physicist of the Bureau of Standards.

You will see, therefore, that there is a preponderance of representation from interests that have properties likely to be damaged by electrolysis.

The speaker is very glad that the American Water Works Association has affiliated itself now with this Joint National Committee, because it makes the representation of owners of underground structures subject to the electrolytic damage that much the stronger.

Mr. Dabney H. Maury said that instead of the pipe owners being in the majority on the National Committee, as alleged by Mr. Ganz, the contrary would be true; because of the community of interests between gas, telephone and electric companies; which would make the water works interests hopelessly in the minority.

He warned the Association against allowing itself to be misled in this respect or to be committed in any way which might be detrimental to its interests.

He also pointed out that the Committee's Report, while apparently like that of the previous Committee on Electrolysis, whose recommendations had been adopted for fourteen years as the official attitude of the Association, yet contained limitations in a number of clauses the effect of which would be to change completely the Association's attitude.

Mr. Leonard Metcalf spoke in support of Mr. Maury's stand.

Professor Ganz explained that the representatives could not have power of authority to commit the Association to anything, but that they would attend the meetings of the Joint Committee and report to the Association any proposed action, and that it would rest with the Association to accept or reject any recommendations made; also contending that the American Water Works Association should be represented in order to know what was being considered by the Joint Committee.

After discussion by Carleton E. Davis, Allen Hazen, President Hill, D. D. Jackson, H. E. Keeler, R. E. Milligan, Morris R. Sherrerd and W. F. Wilcox, the report was by resolution *received*, ordered printed in the minutes, and the committee continued for further consideration.

COMMITTEE ON CITY PLANNING

INTRODUCTION

City planning is the application of foresightedness to municipal matters, particularly those relating to its physical layout. Water works engineers have been working along city planning lines whenever they designed a system looking toward the future, but the work of the water works engineer is often criticized by engineers of other specialties because the former has not taken what the others consider due account of the problems which the latter are called upon to solve.

City planning is simply joint planning so as to provide a better solution of the various problems of the several specialists for the greater good of the greater number. No specialist may be absolutely satisfied nor able to secure the ideal arrangement for his own work, but the public at large may often be benefited by concessions on both sides. Thus the question of the best location for pipes in streets would be settled in one way if no pipes existed except those of the Water Department, whereas the facts usually are that numerous other subsurface structures must be considered so that the water mains cannot be laid exactly in the middle of the street, which seems to some the ideal location. Many other similar questions arise.

The street system, in so far as it has to do with block sizes, affects the economics of the size and arrangement of distributing mains. It would doubtless be productive of interesting results to investigate the most economical arrangement for a square city, laid out with blocks 200 feet square and, also, one with long rectangular blocks 200 feet by 800 feet, as in New York City.

The width of street determines whether it is more economical to install a distributing main which feeds both sides of the street, or two mains to feed the two sides separately. A special report showing the economics of the case and where the dividing lines occur would doubtless be of interest.

The question of carrying service pipes to property lines at the time of repaving or original paving of street, is of interest in city administration and, indirectly, in city planning. Also, the question of trunk mains through the streets and distributing mains on one side or both sides under the sidewalks must be considered in connection with the question of opening the street surfaces from time to time to make repairs and to install new connections.

The plotting of suburbs is a vital item in city planning, and in connection with it might well be considered the theory of extension of water mains into suburban districts,—the installation of large mains at the present time, as against a small main at the present moment, with either an enlarged main at a later date or the installation of additional service or trunk lines.

What period into the future should be considered in estimating pipe sizes is an item of much interest to water works engineers and, therefore, a proper element in planning cities for the future.

The question of pipe galleries and the use of them for water mains is of interest and has been made the subject of investigation and report.

The location of water mains in the street cross section, in connection with the standardization of location of all subsurface structures, has been investigated to some extent and reported upon, but deserves much more study.

The subject of subsurface versus post hydrants is of interest in city planning and has been made the subject of investigation through a questionnaire, a résumé of the answers to which is included in this report.

In connection with obstructions on the sidewalks, the location of hydrants is of importance; and the advantages and disadvantages of installation at corners, in the centers of blocks, on the curb line, against buildings, or in recesses in buildings, etc., have been considered.

The aesthetic design of pumping stations, towers, tanks, dams and other structures is a matter worthy of careful investigation and concerning which an exhaustive collection of photographs should be secured, together with estimates of the difference in cost of artistic and inartistic designs for as many typical cases as possible.

In connection with the aesthetic design of power plants, consideration could profitably be given to the question of the erection of chimneys versus the use of forced draft with practically no chimney to affect the view.

The joint use of areas reserved for protection of reservoirs or drainage basins for park purposes also has been considered, and the parking and park use of areas around pumping plants and other structures which are located closer to congested centres should be discussed.

The economics of the case should be investigated to discover how far it may be wise to combine park use and water works properties, measured perhaps by the number of people who would use the parks if so arranged.

The question of boulevards and parkways over aqueducts and pipe lines might well be investigated.

The establishment of parkways leading to large water works structures as terminal features has been investigated. An excellent example is the Bronx Parkway leading to the Kensico Dam of the enlarged water works system of New York City.

With reference to the joint use of water works property for park use as well, study should be made of the limitations which must be placed upon such park use because of the necessity of conserving the quality of the water where contamination is possible.

The Committee on City Planning has been somewhat hampered because of the inability of some of its members to carry on the investigation work outlined for consideration. The combined use of properties for water works and park purposes, the aesthetic treatment of water works structures, and related questions have been considered by Mr. Armstrong and that portion of the report dealing with those points is of his production. The questions of pipe galleries and the location of mains in the streets have been examined by Mr. Burdick whose report upon that subject is incorporated in this document. The remaining items in the report have been discussed by the Chairman of the Committee.

THE AESTHETICS OF WATER WORKS DESIGN

BY JAMES W. ARMSTRONG

Property acquired in connection with the water supply of cities may be divided into two general classes. The first and most common is the class of real estate purchased for use in connection with the erection of the various structures required for the operation of the system.

No water works system, however small, can be operated without some such holdings; they are generally located within or near the city limits, and surround pumping stations, filter plants, reservoirs and miscellaneous buildings. The area of property of this character owned by different cities varies greatly, depending largely upon the size of the city. It ranges from barely enough to hold the structures to several hundred acres.

The second class is usually held only by cities whose water supply is obtained from some distant source, and where it becomes necessary to secure large tracts of land for impounding reservoirs and for the protection of the water sheds that supply such reservoirs. New York, Boston and Baltimore are examples of cities holding land for such purposes.

It is the practice in many cities to permit the public to use water works property for one purpose or another, and whenever there is no danger in doing so, there is no reason why the custom should not become more general. Public property should be used for the greatest good of the most people, and if water works property can be made to serve the double purpose of usefulness and giving pleasure, it should be so used, but as a pure drinking water is a city's greatest asset, all other uses should be made subservient to that of maintaining an absolutely pure supply. Any use which would create a suspicion in the public mind that the water is being contaminated should, if possible, be avoided.

The number of people using the large parks in some of our cities is comparatively small, owing to their inaccessability, and those who do use them are largely of the well to do classes. The poorer people cannot afford the car fare and the time required to visit such parks very often, hence the improvement and planting of little plots of ground would come as a real boon to many people in the vicinity of such places. Even where they are too small to be used as parks, the beautifying of all the spare ground would add greatly to the attractiveness of a city, and as good habits like bad ones are more or less contagious, might stimulate other property holders to beautify their places. In small cities where there are no parks, water works property could be made to serve as the beginning of a park system.

As the two classes of property require different treatment and development and as the public would evidently make different use of them, it is thought best to consider each class separately.

Taking up the first class of property it will be found that water works pumping stations are usually a matter of some interest to a community and the type of architecture and the surroundings of the buildings have a very decided influence on the neighborhood. The great variation in size, location and surroundings of pumping stations makes it very difficult to offer any very definite suggestions for a proper treatment of the grounds surrounding them. In the larger cities, the buildings are sometimes situated in almost hopelessly ugly surroundings, others are very massive and have very little ground around them. In such cases not much can be done to add to their beauty. There are, however, cases where buildings have sufficient ground around them, if properly treated, to add greatly to the attractiveness of the place.

It is quite common to see a pumping station surrounded by a grass plot without any other growing thing in sight, whereas a few shrubs planted adjacent to the walls would soften the harsh building lines and form an agreeable junction with the lawn.

When large spaces are available, a formal garden, or a semi-formal garden is sometimes employed. Even where the architecture and surroundings are forbidding much can be done to beautify the place, often at a very small outlay of effort and money. A wall or a fence can be built around old storage yards to conceal heaps of cinders and piles of pipe and scrap iron, and then if the enclosure be hidden by planting shrubs and vines and a little grass space be left in front a beautiful effect can be secured and a neighborhood may be transformed.

It hardly seems possible to consider the treatment of buildings and grounds around them separately. In designing buildings they should of course be made appropriate to the surroundings. The writer has seen beautifully designed pumping stations with every architectural detail carefully worked out, that were entirely out of harmony with their country surroundings, because they had the appearance of having been transplanted from a city street. It is a pretty safe rule in planning buildings, that have any appreciable amount of ground around them, to rely on the form and outline of the building for beauty rather than any added ornaments. Simplicity in architectural detail is often equally consistent with beauty and economy. Buildings located in closely built up cities are not considered as coming within the scope of this paper.

Features to be avoided are low flat building lines with monoto-

nous architectural detail, sameness of color and architectural details that are obviously of no service. Straight lines are seldom found in nature, almost never in a horizontal position, therefore, when a building is to be treated in any but a strictly formal manner, it is well to break the sky line by using hipped and pointed roofs and the ground line by planting shrubs adjacent to the buildings. Angles in building walls and projecting roofs cast pleasing shadows. Well designed arches give a sense of lightness and of strength and are always beautiful when used appropriately.

Nature uses both form and color for beautifying objects, usually both. The architect should use both if the best effects are to be secured in building. Strong colors are the most beautiful, but they should be sparingly used. Sometimes pleasing effects are procured by strong contrasts in color, but better and more lasting results are usually obtained by combining moderately contrasting, but harmonious colors. Red, yellow and brown tones are warm and are generally pleasing. Beautiful effects can be secured in gray by combining it with the right colors, but artistic handling is required to get proper results. Gray used alone in large buildings is cold and harsh in feeling. Large buildings built of gray stone with trimmings painted to match produce a very unpleasant effect upon the passer-by that would be considered good looking buildings if roof and wood work had been of some other color.

Local material could often be used to better advantage than is commonly supposed. The writer has seen six or eight large buildings which, though built of the same brick, were very different in color and appearance. The grading of the brick, the kind of mortar and the method of laying, all had decided effects. The most pleasing shades of color were secured by using the entire run of kiln bricks from light red to nearly black. When laid with a wide raked out joint in cement mortar, the difference in color seemed to blend into one harmonious soft shade.

Displeasing effects were produced by selecting bricks of a uniform shade and laying them with a close struck joint in poor quality of lime mortar.

The grounds around filter plants are generally much more extensive than those around pumping stations, and consequently afford better opportunities for treatment. With judicions planting, the construction of few good driveways and proper consideration given to the architectural treatment of buildings, a filtration plant should be-

come one of the most attractive places in a city. This is especially so in connection with filter plants employing open reservoirs, as in themselves, they often add much to the attractiveness of the surroundings. Water is always pleasing even when it is contained in concrete basins adjacent to a group of buildings.

The use of open reservoirs of course requires greater precaution to guard against the pollution of water. Probably the most effective protection is obtained by the type used in the coagulating basins of Louisville and the New Compton Hill reservoirs at St. Louis. In these reservoirs, concrete walls rise vertically to a height of from 10 to 12 feet above the ground level. These walls are treated architecturally with panels and pilasters, but such treatment is formal and the height of the walls cuts off any sight of the water.

In order to relieve the bareness of blank concrete walls and to add to their stability, earth embankments have been made around the walls of the coagulating basins at New Orleans and at Baltimore. The earth is carried within three feet of the top of the wall and the exposed portion acts as an effective barrier to prevent contamination and at the same time permit ready inspection of the water.

At Baltimore a portion of the driveway is high enough to enable persons riding or walking to overlook the basins. By planting a hedge of low growing shrubs such as barberry around the wall, it can be practically hidden from view and a beautiful effect obtained. The hedge also prevents people from getting within reach of the water, but does not obstruct the view.

A very common type of distributing reservoir, but a type very difficult to treat aesthetically, is one built on the top of a hill whose sides are formed by an earth embankment. Such basins unless they are surrounded by roads are generally very well safe guarded against pollution, as the only water that can possibly enter them is that falling on the inner slope and a portion of the crown.

The old reservoir at Minneapolis, the Crescent Hill reservoirs at Louisville and the Forbes Hill reservoirs at Quincy, Massachusetts, are of this type, but differently treated.

At Minneapolis the entire inner slope is paved and surrounded at the top by a heavy flat coping course of stone which supports a heavy iron fence. A 20 foot macadam roadway whose inner edge is flush with the top of the coping and whose outer edge is somewhat lower, surrounds the reservoirs. The outer slope of the embankment is $1\frac{1}{2}$ feet to 1 foot.

The Crescent Hill reservoirs are also paved on the entire inner face and are surrounded by a heavy stone curb and iron fence. Instead of a driveway it has a wide cement walk adjacent to the curb, but 8 or 10 inches below its top the outer slope is much flatter than at Minneapolis.

The Forbes Hill Reservoir is paved on the inner side within 2 feet of the top. There is a 6 foot granolithic walk in the center of the crown, and the remainder of the exposed surfaces are covered with grass. As far as the protection of the water is concerned there is little to choose between the three reservoirs, the one at Louisville perhaps has a little in its favor. The Forbes Hill Reservoir, however, has a decided advantage over the other two in the matter of cost and appearance. The more or less formal treatment of such reservoirs can hardly be avoided, but the writer believes that if half the money that is spent on expensive fences and cut stone curbs were spent in flattening the outer slopes and in making such plantings as the topography permits, much would be done towards overcoming the decidedly artificial look that most of such reservoirs have. The mere rounding of the edges at the crest and top of the slope would in many instances be a relief.

Another common type of reservoir and one that offers possibly the greatest opportunities for beautiful treatment is formed in a valley or ravine by damming up the lower end. Such reservoirs are generally surrounded or are partially surrounded by a driveway, and therefore, require careful consideration in order to preserve the purity of the water. When a community wants the best possible treatment of such a reservoir it is desirable to secure the advice of a landscape architect. It is believed the treatment should be as natural as possible and that all artificial details be avoided. Nature generally comes to the assistance of the engineer in planning these reservoirs as, the outlines are generally irregular and are seldom displeasing. When engineering works are necessary a few simple expedients will serve to maintain the natural appearance. A geometrical or stiff outline should always be avoided. A succession of circular curves joined by tangents gives a stiff and unnatural appearance. Straight lines, especially when they form angles with other straight lines, are displeasing. An earthen dam can be built on a curve with the inner sides of the curve facing either towards or away from the water and be fully as stable as one built on straight lines.

Low growing dense shrubs planted near the water's edge do not contaminate the water, but on the contrary serve as an efficient barrier and prevent leaves and paper from reaching the water.

Lake Montebello, a distributing reservoir of Baltimore, is thoroughly protected and in a manner approximately natural. The lake is paved with rip rap slightly above the water line; from the edge of the paving to the crest is a narrow grass slope, and on the crest of the embankment, which is slightly above the roadway surrounding the lake, is a dense hedge of pyrus japonica about 3½ feet high. Water falling upon the road is removed through catch basins and a system of tile drains. The particular merit of this treatment is the splendid protection afforded the water without the erection of a fence or a heavy curb.

The storage reservoirs built in connection with the filter plant at Cincinnati are paved from the top to the bottom and are surrounded by a heavy curb, and outside the curb by a paved driveway. The protection is excellent and the outlines of the reservoirs are generally pleasing, but there is a harshness due to much exposed concrete that is only partially relieved by the beautiful hills in the back ground.

Spot Pond of Boston and Fresh Pond of Cambridge are reservoirs having a near natural treatment in some details very pleasing, but it is necessary at both places to patrol the shores constantly to prevent contamination of the water.

When appropriate land is held that can be readilly reached, golf links can sometimes be maintained to the mutual advantage of the water boards and the parties using them. In Baltimore a large tract of land adjacent to Lake Roland is turned over to the Baltimore Country Club to be used for golf grounds. The club at its own expense maintains the grounds in excellent condition and relieves the board of all responsibility in the matter.

These golf links are extensively used whenever conditions permit and no objection has been found to the use of the ground for that purpose. In fact a large section of ground which is naturally beautiful is kept in much better condition than it would otherwise have been, and is a source of pleasure and added health to many people. If the ground was not so used it would be frequented by no one and the only useful purpose served in holding it would be to prevent its being occupied by objectionable institutions which contaminate the water supply.

The Louisville Water Company owns a tract of about 100 acres of ground which surround their river pumping station. This tract was at one time used as a public park, but is now rented to a country club which maintains a club house and golf links on the property and uses the old reservoir for a swimming pool.

PIPE GALLERIES AND THE LOCATION OF MAINS

BY CHARLES B. BURDICK

The committee sent the following questions to a large portion of the membership of the Association, relating to the location of water pipes.

1. What rule, if any, governs the location of water pipe in your streets?
2. Do you lay pipe in the parkway between the curb and the sidewalk in residence streets, and if so, under what circumstances?
3. If so, what precautions do you find necessary to prevent injury to the trees?
4. If a pipe is laid in the parkway on one side of the street only, what plan do you adopt for feeding the services on the far side of the street?
5. Is there any standard location for all other sub-surface structures? If so, please furnish diagrams.
6. Are house connections installed at the time main is laid?

The replies to these questions are tabulated below. In general the replies brought out the fact that the practice of locating the sewer in the center of the street is almost universal, with one side of the street reserved for gas, and the opposite side for water. In general, conduits for wires are located close to the curb line.

The use of the parkways for pipe in residence districts seems to be decided on the basis of economy at the time the pipe was laid. Most of the replies indicate that the main is laid in the street unless it is paved, in which case the main is frequently laid in one or both parkways depending upon circumstances. The use of two pipes seems to be quite common on very wide streets or in business streets containing car tracks.

The practice of laying services to the curb line in advance of new pavement seems to be on the wane. A number of cities report the abandonment of this practice.

Answers to questionnaire regarding water pipe locations

	RULE GOVERNING LOCATION OF WATER PIPE IN STREETS	PIPE IN PARKWAYS AND UNDER WHAT CIRCUMSTANCES	PRECAUTIONS TO PROTECT TREES WHEN LAYING PIPE IN PARKWAYS	WITH PIPE IN PARKWAYS HOW IS FAR SIDE OF STREET FED	HAVE YOU A STANDARD LOCATION FOR ALL UNDERGROUND STRUCTURES	ARE HOUSE CONNECTIONS INSTALLED WHEN MAIN IS LAID
Rochester, N. Y. E. A. Fisher, Consulting Engineer	Between gas and sewer	Yes on wide streets	Tunnel under roots	Lay another pipe	General rule beginning at curb, electric, gas, then water lay two water pipe where double car tracks	In advance of pavement
Chicago, Ill. John Ericson, City Engineer	8 to 10 feet north and west of street center	Yes on double streets or very wide streets	As directed by city forester	Two mains	No	In advance of pavement
Toronto, Ont. F. A. Dallyn, Private Sanitary Engineer	17 feet from street line 2 mains on business streets	Two Mains in carline streets	Trees not harmed in parkways	Services carried across street	No	No
Auburn, N. Y. J. Walter Ackerman, Chief Engineer and Superintendent	10 feet from street centers	No—other utilities use this space			No	
J. N. Chester, Chester and Fleming, Engineers	At least 6 feet from from curb	On paved streets		Two mains one large one small		
H. C. Hodgekins, Consulting Engineer	So far as possible a uniform distance from curb	Yes if parkway permits		Generally services cross the street		In advance of pavement
Raleigh, N. C. E. B. Bain, superintendent	10 feet from East and North curbs					

Minneapolis F. W. Cappelen, City Engineer	North and west sides of street	No			Sewers center; conduits two sides near curb. Water 16 to 30 feet from curb depending on street width. Gas on opposite side of street	No
St. Louis Frank L. Wilcox		On streets already paved		Two pipes		About one-half
New Orleans Geo. G. Earl, General Superintendent		Frequently to save cost		Services "jacked" across the street—also under pavement	Sewers center; storm drains near curb. Gas and water between	No except for user
New York Wm. W. Brush and H. B. Machen	North and west sides of street, 6 to 9 feet from curb	Residence streets pavement where trees permit	Box to keep earth away	Two mains on streets over 80 feet	General conditions. Curb to 4 feet electric. Gas 6 feet from curb. Water 9 feet from curb. Sewer in center	No
Utica, N. Y. Consolidated Water Co.		Yes	None		No	In advance of pavement
Milwaukee, Wis. H. P. Bohmann, Superintendent, Water Works	North and east sides of street	Yes on double streets				In advance of pavement
Philadelphia A. H. Kneen		In exceptional cases		Two pipes, one large one small		
Baltimore, Md. James W. Armstrong, Filtration Engineer		In suburbs to avoid paving	Offset the pipe	Two pipes in most cases		
Winnipeg, Man. Thos. H. Hooper, Superintendent, Water Works	14 feet from east and south street lines 2 mains on very wide streets			Bore under the streets and shove services through		In advance of pavement

Answers to questionnaire regarding water pipe locations—Continued

	RULE GOVERNING LOCATION OF WATER PIPE IN STREETS	PIPE IN PARKWAYS AND UNDER WHAT CIRCUMSTANCES	PRECAUTIONS TO PROTECT TREES WHEN LAYING PIPE IN PARKWAYS	WITH PIPE IN PARKWAYS HOW IS FAR SIDE OF STREET FED	HAVE YOU A STANDARD LOCATION FOR ALL UNDERGROUND STRUCTURES	ARE HOUSE CONNECTIONS INSTALLED WHEN MAIN IS LAID
St. Louis, Mo. Francis T. Cutts, Assistant to Water Commissioner	Usually 22 feet from Property line	In exceptional cases		Usually 2 mains, in some cases tile pipes to shove services through	Gas south and east Water north and west sides of street	Practice abandoned
Wilkinsburg, Pa. W. C. Hawley, Chief Engineer and General Superintendent Pennsylvania Water Co.	North and east side street 3 to 10 feet from curb	When required by city		Have used tile pipes		No
Davenport, Ia. Dav. Water Co., C. R. Henderson, Manager	12 feet from north and west curb	No			Gas in side opposite to water main Sewers in center—Other utilities in parkway or in alleys	In advance of pavement
A. Prescott Folwell	North and east sides of streets usually 5 feet from curb					

UTILITY GALLERIES

In the larger cities of this country the growing necessity for the tearing up of pavements in the construction and maintenance of the utility distribution systems and their service connections has led to several studies looking toward galleries beneath the streets or sidewalks for the purpose of accommodating such utilities as water, gas, electricity, telegraph and telephone. Although the practicabilities of this matter have not been determined fully, the studies indicate that it is essentially a large city problem. The costs involved are probably not warranted in the smaller cities except in special cases.

The need for a service of this kind has been most evident in the business districts of the larger cities. In Chicago for instance, the inner zone or principal business district contains 21 miles of streets and about 220 miles of utility lines, or an average of more than ten lines in each street. To a large extent this has been the result of the growth of the district both as regards the area developed and lately, the increasing height of the buildings with the consequent demand for increased service. Some of the more congested streets contain as many as nine gas mains. Most of the streets contain five or six gas mains, and in many of the streets the water mains are duplicated.

As high as eighteen pipe or conduit lines are accommodated between curbs 38 feet apart. As these conduits have been laid at different times, they are obliged to pick their way among conduits previously laid. At intersecting streets there are the added facilities for the interconnection of intersecting lines, vaults for the accommodation of valves, and municipal fire hydrants. There are certain congested street intersections in Chicago where as high as forty-one iron manhole covers are visible on the street surface.

Although the under-street congestion in New York, Chicago and other large cities is comparable or even exceeds the congestion above the surface, there is practically no American experience in utility galleries, socalled, for the accommodation of the subsurface utilities. We must look to Europe for actual accomplishment, and outside of London and Paris, the European experience has been extremely limited.

The London experience indicates that utility galleries as applied to streets where the investment in utilities is already made is not

financially practicable, but where new streets are opened, such galleries are warranted and the London practice is to build them, renting space to the private corporations. London has 8 miles of galleries and fifty years' experience in their operation.

The conditions in the large American cities differ from the conditions in London as to the height of the buildings, the greater use of the utilities, and particularly the rapid growth in the use of high buildings. This growth has by no means stopped, and therefore, the present facilities must be greatly increased hereafter, involving the inevitable opening and reopening of the streets, not to mention the frequent street openings for repairs and the connection of services.

The following résumé of the European experience is the result of an inspection trip by Mr. Louis A. Dumond, Secretary-Engineer for the Chicago Commission on Down-Town Municipal Improvements. This inspection was made immediately prior to the outbreak of the war in 1914.

FOREIGN EXPERIENCE

It appears that in the larger cities of Germany where the utilities are all municipally owned, the pipes and conduits are generally accommodated under the sidewalks. This space is not occupied by the cellars of buildings and the pipes and conduits are buried under tile sidewalks which are so constructed that the tiles may be removed locally for the purpose of access to the utilities by digging. It is possible to accommodate utilities in this manner through the careful allotment of space and the maintenance of accurate records of the utilities so buried. By this procedure the street pavements are not disturbed, but it would appear that the German procedure in a large measure simply transfers the principal objections to American practice from the street to the sidewalk.

In Paris the sewers are built exceptionally large, permitting of direct access for cleaning and the connection of premises through passages accessible from the sewer. The sewers also house the water pipes and the wires for the distribution of electricity and telephone service. The gas pipes are buried in the street or in the space adjoining same. It has not been considered safe in Paris to carry the gas pipes within the sewers, although space is available. No evidence could be found, however, that the procedure has been

tried. All the sewers in the business district, and all the main sewers throughout the other districts of Paris are thus exceptionally large as described. Short lateral sewers only are so small as to prevent the ingress of workmen for the purpose of cleaning or for the accommodation of the utility services.

London is the only city in the world with extensive experience in underground galleries for the accommodation of pipe utilities. At the present time about eight miles of such subways and galleries are in use. They have been gradually developed since the construction of the first gallery in 1861, and are only built where new streets are opened up. It is stated that they have carefully considered the general application of gallery construction to the more congested streets of London, but that under London conditions, it is not financially practicable to build such galleries in streets previously equipped with the utility distribution systems. It is the practice in London upon the narrow streets, to build one subway near the center of the street, and upon wider streets two subways located near the curbs, with side connections of small dimensions through which the services may be connected to the adjoining property. The subways as built range in height from 7 to 9 feet, and in width from 8 to 16 feet, depending upon the requirements of the street. All utilities in London except sewers are privately owned. The galleries accommodate the water supply, gas, electricity, telephone, and in some cases, the sewers.

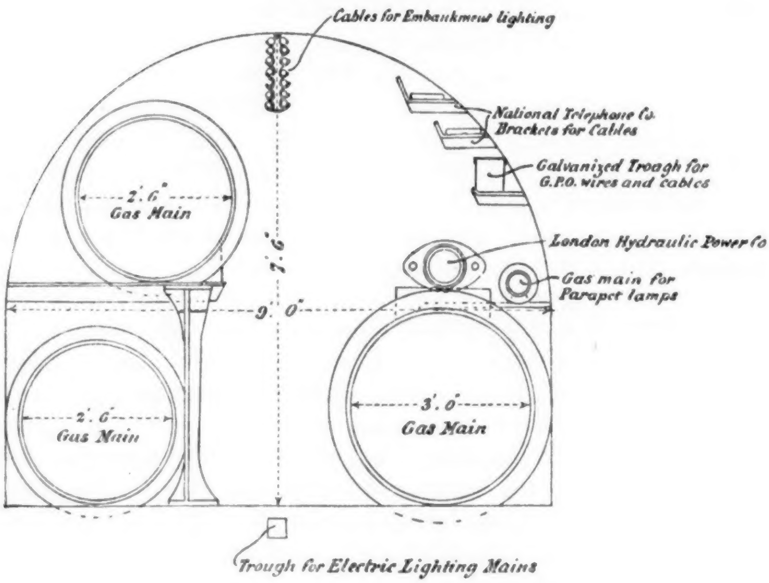
Figure 1 is a cross-section of the utility gallery upon the Victoria embankment. It is interesting to note the comparatively large space occupied by gas and the extremely small space occupied by the electric lighting, and it will be observed that cables are carried upon brackets and shelves.

The position of London as regards ownership of the public utilities is similar to that of most American cities. With the exception of a part of the water supply, and a few of the tramway lines, all public utilities are privately owned. Since the pipe subways are all constructed in new streets, the problem of forcing public utility companies to occupy the same is somewhat simplified.

In order to regulate the use of the pipe subways by the various public utility companies to provide a revenue, by-laws were passed by the London City Council in accordance with the Subway Act of 1893. These by-laws provide for the manner of securing occupancy in the subways for main conduits and services, access for

repairs, provisions for safety, and the maintenance of records. A scale of rentals is fixed for the different kinds of utilities. In the fixing of rates, a sharp distinction is made between water and gas companies having power to "break up the streets," and such companies as do not require the removal of pavements for repairs and the connection of services. The rates are said to be figured upon the basis of the money saved to the companies by the use of the

LONDON COUNTY COUNCIL SUBWAYS
VICTORIA EMBANKMENT



SCALE—3/4 IN. TO A FOOT

FIG. 1

pipe subways above what the cost would be were the utilities buried in the streets.

A distinctive feature of the English subways is the ample provision made for ventilation. This and the thorough system of inspection, and the more or less constant occupancy of the subways by the repair men for the various companies, apparently accounts for the freedom from accident due to gas explosions. In the Nottingham galleries which are typical of the galleries in London,

ventilation is furnished by iron grids in the roof of the subway at 50 foot intervals.

In addition to the galleries of London, other cities in Great Britain have utility galleries in a few streets as follows:

Nottingham, population 259,000, four subways with an aggregate length of 2,772 feet, St. Helens, three subways, total length 2,040 feet, and Glasgow where a short subway 345 feet has been in use since 1902. A short gallery is in use in Milan, Italy.

CHICAGO

Within the past year a utility subway has been built in Chicago adjacent to the new Pennsylvania Railway Terminal. This subway occupies slightly more than three blocks of length (1860 feet) in Canal Street and Monroe Street. The lengths and cross-sections are as follows (the dimensions refer to clear inside widths and heights), 1360 feet of subway 6 feet wide and 8 feet high; 500 feet of subway 4 feet wide by 8 feet high.

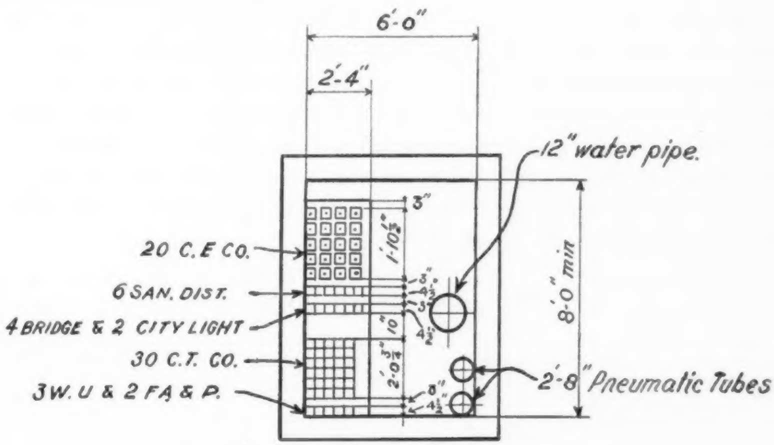


FIG. 2. CROSS SECTION CHICAGO SUBWAY

This subway is located under the sidewalk space, except in Monroe Street where the street near the curb is occupied, in a locality where the sub-sidewalk space has not been used in the basements of the buildings. Figure 2 is a typical cross-section. Inspection is particularly invited to the manner in which electric cables and also the other cables are accommodated in the subways. They are

all carried in tile ducts surrounded by concrete. This is the same construction generally pursued in Chicago where utilities are laid under the pavements. The cables enter the ducts only at the manholes near street intersections. Therefore, so far as the companies using cables are concerned, the subway thus occupied produces no saving in maintenance. The galleries contain or will contain the city water pipes, two 8-inch pneumatic tubes used in the transfer of mail between the railway stations and the postoffice, 20 ducts for accommodating the electric cables of the Commonwealth Edison Company, 6 ducts for the electric cables of the Sanitary District used in street lighting, 6 ducts for the accommodation of light and power for the city bridges, 30 ducts for the Chicago Telephone Company, and 5 ducts for accommodating telegraph wires.

A portion of this utility gallery was built by the city of Chicago, and another portion by the Pennsylvania Railroad Company. That portion constructed by the city was one block in length. It included the intersection of Canal and Madison Streets. Madison Street is a very busy thoroughfare with double car tracks. At this place the width of the subway is increased for the purpose of ingress, the interconnection of cables, etc. The aggregate length of gallery constructed by the city was 460 feet, and the cost complete was $16,003.03, an average cost of about $35 per lineal foot of gallery. It is said that about one-third of this cost was incurred at the crossing of Madison Street on account of special provisions for handling the street traffic during construction.

NEW YORK UTILITY GALLERY

It is understood that a short utility gallery was constructed in New York some years ago, but for some unknown reason it has not been occupied.

FINANCIAL PRACTICABILITY

The costs of utility gallery construction, including the expenditure for galleries, the removal of existing utilities and their relocation in the galleries, including the cost of cutting and reconnecting the services must be justified by the following prospective benefits.

(a) The saving in pavement openings for repairs and enlargements.

(b) A reduction in the cost of general pavement maintenance.

(c) A longer life for pavements.

(d) A reduction in the operating cost of some or all of the utilities.

(e) A saving in the cost of the future extension of the utilities.

(f) A reduced leakage of water and gas.

(g) The value to the public of good streets and decreased interference with travel.

As to whether the benefits are sufficiently great to warrant the costs involved is a special problem not only for each city, but for each locality. The question as to practicability cannot be answered broadly except in general that it concerns the congested districts of the larger cities only. Special occasions will arise where extensive improvements for other purposes involve the relocation of utilities, as in the Union Depot improvements at Chicago and the proposed transportation subways in Chicago. When such opportunities occur, the orderly relocation of the utilities in the best way possible should receive most careful study.

HYDRANT DESIGN AND LOCATION

BY E. P. GOODRICH

Concerning the subject of hydrant design and location, a total of 183 requests for information were sent out, to which questionnaires 24 answers had been received to and including May 22nd. This is 13 per cent. The replies were derived from men located in 18 cities but because of the fact that several of those answering the questions were consulting engineers whose practice was not confined to the locality of their address, the field covered is much wider than simply the 18 cities listed. Roughly, the territory extends from Toronto and Winnipeg on the north to New Orleans on the south, from New York City to St. Louis, as follows: Auburn, N. Y.; Toronto, Canada; Baltimore, Md.; New Orleans, La.; Raleigh, N. C.; Chicago, Ill.; Milwaukee, Wis.; Rochester, N. Y.; New York, N. Y.; Wilkinsburg, Pa.; Canton, O.; Davenport, Ia.; Pittsburgh, Pa.; Syracuse, N. Y.; Charlotte, N. C.; Philadelphia, Pa.; St. Louis, Mo.; Utica, N. Y.

Several of those to whom questionnaires were addressed courteously forwarded them to others for answer.

The following questions were submitted:

Questionnaire with reference to fire hydrants

Hydrants

Have you ever used subsurface hydrants?
If so, with what success?
If not, what is your idea about them?
- In comparison with the supersurface type as to
  - Cost of installation
  - Cost of maintenance
  - Time for fire department to make connection
  - Liability to become frozen
  - Difficulty of identifying location of by fire department
  - Accidents to those stumbling over them
  - Proportion of hydrants to total sidewalk encumbrances
  - Necessary width of walk occupied with corresponding restriction to pedestrian traffic.

What is the best longitudinal location for fire hydrants with reference to street corners, at corner, center of block or elsewhere?
- From point of view of
  - Fire department
  - Traffic police
  - Water department

What is the relative weight to be attached to each point of view?
What is the best lateral location for fire hydrants with reference to the sidewalk, at curb, just in front of building, or in recess in building?
- From point of view of
  - Fire department
  - Water department
  - Traffic police

What is the relative weight to be attached to each point of view?

Comments concerning the use of sub-surface hydrants were received from 18 who had had no experience and 5 who had had experience. The universal distrust of this type of hydrant by those who had not had any experience with it was striking, while a majority of those who had had experience with it were favorable to its use. All of the favorable replies are included in this report and one or two typical answers of the negative variety. In general, those opposed thought that the post type of hydrant was preferable except in congested sections of large cities, no need for the elimination of the post being felt in towns or smaller cities up to populations of 40,000 to 45,000. Possible objection was also voiced to this type of hydrant by volunteer fire departments and the point was made that difficulty in identifying the location, especially in northern climates where the covers might be deeply overlaid with snow and ice, were the principal reasons against the use of the subsurface variety.

As to the best longitudinal location for fire hydrants, the opinion was almost universal that a location just behind the building line at the street corner was best, together with hydrants located near the centers of blocks in which alleys were to be found or the lengths of which were 500 feet and upwards in business districts and 600 feet and upwards in residence districts. The spacing was also made to depend upon the fire hazard in some places. The corner location is considered preferable because of the availability of fire service upon the fronts of two sides of a block, and since less friction exists and a correspondingly greater quantity of water is available. Some men advocate hydrants on opposite corners of an intersection where conditions are deemed special and many point out the advantage of having the hydrant connection just inside the control valve for the block, although one engineer pointed out the desirability of separate hydrant valves.

Every variety of reason was given in favor of a location as close as possible to the curb and against any other place. Extra length of suction hose for the fire engines, obstruction by such hose to the police and firemen during fires, greater difficulty in operating a hydrant wrench in opening the hydrant, etc., are many reasons given against a location close to the building.

The fire department was always given preference as to its opinion with reference to the location, while traffic conditions were considered of less moment. It should be noted in this connection that the questionnaire was not sent out to fire departments or traffic police.

Excerpts from interesting letters were as follows:

From letter of A. H. Kneen, American Pipe and Construction Company, Philadelphia, Pa.

April 18, 1916.

Subsurface Hydrants:[1]

Have you ever used subsurface hydrants?

"No, but very common in Europe. Their location is marked on the side of buildings and they are always placed according to a definite and easily perceived plan. Paris is a good example."

If so, with what success?

If not, what is your idea about them?

Answers to both queries to include comparison with the supersurface type as to

Cost of installation.

"Less."

Cost of maintenance.

"Less."

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[1] or rather like curb and top level with surface.

Time for fire department to make connection.
"No trouble."
Liability to become frozen.
"Real objection."
Difficulty of identifying location of by fire department.
"Always on sidewalk at same exact relative position."
Accidents to those stumbling over them.
"None."

From letter of H. B. Machen, Borough Engineer, The City of New York, Department of Water Supply, Gas and Electricity.

April 26, 1916.

Question 1—Have you ever used subsurface hydrants?

In 1910 there were four subsurface hydrants of record in the borough of Manhattan, New York City. As fire hydrants they were not successful and were not used by the fire department due to lack of knowledge as to their location. In the course of general cleaning up of the water supply system the subsurface hydrants were removed and hydrants of standard type placed in their stead. In winter time these hydrants might be out of service due to the fact that the cover could freeze tight; water might collect under the cover and freeze the nozzles and caps into a mass of solid ice. Snow might cover the walk, necessitating clearing of same to obtain access to the hydrant.

It would be necessary to have indicator sign attached to a building to show where subsurface hydrants were located. In many streets where large plate glass windows are the rule, there would be no available space to attach indicator unless put up as high as the second story of the building.

A properly designed subsurface hydrant should not cost any more to install or to maintain than hydrants of the standard type.

There is no danger of a pedestrian stumbling over a hydrant cover if it is properly designed to set flush with the walk.

A standard hydrant requires a clearance from the face of the curb of about 14 inches in order that the hubs of the passing vehicles will not interfere with the nozzles. The barrel of the hydrant is about 8 inches in diameter. The obstruction on the sidewalk is therefore 22 inches. A subsurface hydrant occupies a space about 3 x 3 feet set 6 inches back from the face of the curb but does not interfere with traffic.

From letter of James W. Armstrong, Filtration Engineer, Water Department, City of Baltimore, Maryland.

April 28, 1916.

In answer to your questionnaire of April 13, in regard to hydrants, I beg to say that subsurface fire hydrants have never been used in connection with the distribution system of the water department of this city and we therefore have no data or means of making a comparison between them and the regular hydrants. However, the fire department of this city installed a high pressure system throughout the business section and placed a large number of subsurface hydrants in connection with the same and so far as I know, they have been entirely satisfactory on that service.

From letter of Allen Hazen, Consulting Engineer.

April 18, 1916.

I am glad to see that you have up the question of subsurface hydrants. Such hydrants were formerly used in Lawrence, where I first lived after my school days, and in a number of other New England mill towns. I remember warm discussions as to their relative merits. I did not take part in these discussions, but was frequently present, and there were warm partisans on both sides. The post hydrants finally won out, as I remember it, solely on the ground that they were more easily found after snowstorms. The old hydrants were directly over the mains in the streets. Every hydrant was referenced and after every snowstorm men had to go around and dig out the top of the pit in which the hydrant was located, and failure to have this work done on some critical occasions resulting in delay to get the water, was, I think, principally responsible for the final shift in the system. This is an old recollection on my part and is to be taken in general terms only, as I was not a party to the transaction and my recollection after so many years may not be exact.

To come to modern times, I have found hydrants of this same general type in use in Australia and other warm places where the water works have been laid out by English engineers. The advantages of hydrants of this type where snow does not exist are so great that I have often wondered why someone did not take this up and get a modern up-to-date design of a hydrant something like that used in Australia, or like that used in Lawrence in the old days. It would seem to me that such a hydrant would be better than the post hydrants in many respects, and especially where the snowfall is not heavy and where there is not much frost to contend with. This would include all the cities on the Pacific Coast, Honolulu, Panama and all Southern cities. The use of American hydrants fitted with frost boxes in Honolulu and Panama has been a source of amusement to many visitors.

For discussion of the old Lowrey hydrants and their relative merits and disadvantages, I would suggest a study of water works and engineering literature, say from 1890 to 1895, that being my recollection of the time when the discussion was most active.

From letter of Thomas H. Hooper, Operating Superintendent of Water Works, Winnipeg, Manitoba, Canada.

May 11, 1916.

The only style of subsurface hydrant in use in this city, Winnipeg, was the ball type of hydrant. It was discarded many years ago for loss of time installing stand pipe and on account of frequent leaks at ball valve and for reasons stated below:

The cost of installation is in favor of subsurface as compared with supersurface.

The cost of maintenance is about the same.

The fire department can make connection to supersurface much more speedily than to subsurface.

The liability to become frozen depends very largely on the system of inspection during the cold weather. In this city during the winter months the sidewalks are generally covered with snow which would cause consider-

able loss of time in identifying location of sub-surface hydrants. The super-surface hydrants now in use, after a big snowstorm have to be dug out as the snow buries them.

No accidents have ever occurred from people stumbling over hydrants, as they stand on an average about two feet six inches above the walk.

Hydrants in this city are the only sidewalk encumbrances.

From letter of Francis T. Cutts, Assistant Water Commissioner, City of St. Louis, Department of Public Utilities, Water Division.

May 15, 1916.

Subsurface hydrants have been used in St. Louis very extensively. At the time that they were installed, there was also in use a post type of hydrant, both the post and subsurface hydrants require a box or vault around them. This requirement made the cost of installation and maintenance about the same for each type. There are no records to indicate that there was any particular delay to the fire department in making connection to an underground hydrant more than to a post hydrant, except in severe weather when it might become necessary to loosen the cover. This, however, was never a serious matter, and was usually done by hitting it a sharp rap with the shovel or pick handle. One of the serious objections to this type of hydrant was the necessity of frequent cleaning after deep snows and the difficulty that the fire department experienced in locating the hydrants promptly, especially where they were placed in unimproved portions of the city and in lumber yards, etc. It was frequently the practice to bury a small piece of cast iron pipe along side the hydrants so as to prevent teaming over them and also to assist in locating them. The serious accidents resulting from people stumbling over the hydrants were few and far between and only occasionally was the city called upon to defend a suit brought about by an accident of this kind. It is difficult to state the proportion of hydrants to the total sidewalk encumbrances, but as a general proposition other encumbrances greatly outnumber the hydrants.

From letter of W. C. Hawley, Chief Engineer and General Superintendent Pennsylvania Water Company, Wilkinsburg, Pa.

April 18, 1916.

Replying to the inquiries accompanying your note of the 13th instant would say that I have had no experience with subsurface hydrants and therefore am unable to answer any of the questions regarding them which you have asked. They may be satisfactory in the thickly built up portions of a large city, but I would not favor them for residence districts or for smaller cities or towns. There are too many times when sleet, snow and ice would render them sufficiently inaccessible to cause serious waste of time in case of fire.

From letter of C. R. Henderson, Manager, Davenport Water Company, Davenport, Iowa.

April 22, 1916.

Contrary to the best practice, hydrants are used very extensively for municipal purposes other than fire extinquishment. Independent valves are

connected to hydrant nozzles and pressure is left on at nozzles during the months of the year when water does not freeze. These are used for street sprinkling and street flushing, sometimes for construction work.

From letter of A. Prescott Folwell, Editor Municipal Journal, New York.

April 21, 1916.

Given a post hydrant, it seems to me that the best longitudinal location depends upon the arrangement of the city. In a residence section where there are alleys, a fire hydrant near the center of the block and alley corner would be furthest from any interference with its use by burning buildings, and would be convenient for fighting the fires from the rear and side. On the other hand, fire hydrants at the street corners are most convenient for reaching the fronts of buildings but would be near the fire should a corner building burn. If placed directly at the corner of the curbs, the hydrant is in a position of greatest danger of accident from trucks and other heavy vehicles. Anywhere between there and the property line extended, the hydrant is likely to be in the way of pedestrians. My own opinion and experience have been that, except for residence sections with alleys, the best location for the fire hydrant is along the curb just back of the extension of the building line. I have usually placed the water main valves on the building line extension. As to lateral location; from the point of view of the fire department, I presume the curb is undoubtedly best, especially for the steamer connections. Most steamers do not carry a suction long enough to run across the sidewalk when the engine is in the roadway. On the other hand, a fire hydrant either recessed in the building, or immediately against the walls is the least obstructive to traffic, while the heat of the building would tend to prevent freezing of the hydrant. But if this building itself be on fire, it might be impossible to maintain any hose connection with the hydrant, and the collapse of the walls would be likely to put it out of commission and probably break the connection.

CONCLUSION

It is believed that this question of the relationship of water works design and construction to other elements of city planning is well worthy of further investigation, and it is hoped that sufficient interest will be demonstrated by the membership to lead to the continuation of the committee for another year so that it may amplify the work already done and develop new fields.

President Hill: Gentlemen, we are peculiarly indebted to Mr. Goodrich for having undertaken this work this year. It seems to the chair that the general field of city planning opens up an entirely new vista for the water works engineer; and that this Association should lend its aid and support to a general broad economic plan of developing all city work. No doubt if figures could be obtained

showing the great loss in this country resulting from haphazard city work due to the lack of coördination between city departments, that these losses would run up into millions, and possibly billions of dollars; not only that, results may be achieved through which our cities may be made more beautiful and our homes more attractive and our environments more conducive to pleasant living. Let us hope that this is only the beginning of a keen interest in this subject on the part of this Association.

Mr. Allen Hazen: The speaker is very much pleased to have heard Mr. Goodrich define the scheme of the combined use of watershed lands both as a source of water supply and as parks. It is something that he has been advocating for years. There is a great deal of merit in it. It has received some consideration by American cities. It deserves a great deal more.

There is another opportunity for combination which would be useful in many cities. Some of our cities are built in valleys, and when these become flooded there is a great deal of damaged property, and very large expenditures are necessary to protect such valley cities from devastation. If the lower parts of those valleys could be taken for park purposes, and people kept from building permanent structures in them, it would also provide a flood channel and would solve some troublesome problems.

The proposal to use subsurface hydrants in city streets in place of post hydrants is also interesting, because the speaker happens to have spent five years in a town where subsurface hydrants were used, and there was much discussion heard as to their merits and disadvantages. Post hydrants were finally adopted solely on the score of the convenience of finding them after a snowstorm and for no other reason. Now the underground hydrant certainly has advantages. The speaker has seen a great deal of underground hydrants in Australia designed by British engineers, and in other parts of the world, and is quite enthusiastic about their merits. They could be used in a large part of the United States, especially on the Pacific Coast. The advantage of that kind of a hydrant is so great that it ought to be adopted in many cases. There is no American

hydrant of this type made so far as the speaker knows:[2] and he most earnestly urges upon our associate members the desirability of constructing hydrants along the line of the British design that will give us a good working design for underground hydrants that can be used in the South and along the Pacific Coast, and wherever there would be no trouble from snow or severe frost.

MR. J. M. DIVEN: One objection to subsurface fire hydrants at street intersections that has not been brought out is the obstruction to traffic caused by removing the snow from the hydrant covers at such places. It would leave a bare spot in the middle of the street intersection, and if the snow was deep a considerable depression, one deep enough to be dangerous to traffic. Probably in uncovering the hydrants after a snow fall, the snow would be piled up about the hole made to find the hydrant, thus increasing the danger to traffic. Such excavations might possibly be made with long sloping sides and thus avoid the dangerous hole at the street intersection; but the chances are that in the hurry to clear the hydrant the snow would be disposed of in the easiest and quickest possible manner, that is, piling it up as near the hole as possible.

On motion of Theo. A. Leisen the report was accepted, ordered printed in the JOURNAL and the Committee continued.

THIRD SESSION, WEDNESDAY MORNING, JUNE 7, 1916

The Convention met pursuant to adjournment, President Nicholas S. Hill, Jr., in the chair.

Mr. Clarence R. Knowles, Superintendent Water Department, I. C. R. R., Chicago, Ill., presented his paper on "Prevention of Water Waste on Railroads," illustrated by lantern slides (published in June JOURNAL), which was discussed by Messrs. Diven and Carleton E. Davis.

Mr. Mark Wolff presented his paper on "Interpretation of Water Works Accounts," Illustrated by lantern slides (published in June JOURNAL), which was discussed by the following: Messrs. Allen

[2] The speaker has since been informed that one or more of our Associate Members have made subsurface hydrants for use in Cuba and Mexico, but except the old Lowrey hydrants used many years ago and now discarded, he has never found subsurface hydrants in ordinary use in the United States or even in the tropics in Hawaii and Panama.

Hazen, F. T. Kimble, W. E. Miller, W. Z. Smith and C. B. Salmon.

Mr. J. N. Chester, H. E. and M. E., Pittsburgh, Pa., read his paper on "Pumping machinery, Test Duty Versus Operating Results" (published in June JOURNAL), which was discussed by President Nicholas S. Hill, Jr., W. F. Wilcox, J. W. Alvord, Allen Hazen, H. G. H. Tarr, Harry Ellsworth, Dabney H. Maury, and S. B. Applebaum.

The Chair called for the report of the Committee on Stream and Lake Pollution, Mr. Theodore A. Leisen, General Superintendent, Detroit, Chairman, in response to which Mr. Leisen stated as follows:

We have no report to present at this meeting, finding it impossible to get together and get a report that would be worth while presenting at this meeting, we ask that an extension of time be given us so that the report can be prepared in the comparatively near future, and published in the JOURNAL at the earliest possible date.

On motion of Mr. Maury, the Committee on Stream and Lake Pollution was continued with instructions to report as early as possible.

ELECTION OF NOMINATING COMMITTEE AND SELECTION OF 1917 CONVENTION CITY

The Chair read from the constitution the provisions relative to the election of Nominating Committee and representation thereon from the various Sections, and proceeded to call for nominations from the respective sections.

The following named were elected as the nominating committee, to nominate officers to be elected by ballot, for the year commencing with the close of the next annual convention.

For the New England States:

George W. Batchelder, Worcester, Massachusetts.

For the Middle States:

George A. Johnson, New York City.

For the Central States:

Frank C. Jordan, Indianapolis, Indiana.

For the Southern States:

E. E. Wall, St. Louis, Missouri.

For the remainder of the United States and all outside territory:

H. Hymmen, Berlin, Ontario, Canada.

SELECTION OF 1917 CONVENTION CITY

The Convention then proceeded to the selection of the next place of meeting. The chair called for the Report of the General Committee of Arrangements as to cities available, which was submitted by Mr. Theodore A. Leisen, as follows:

REPORT OF JOINT COMMITTEE OF ARRANGEMENTS

The Joint Committee on Arrangements of the American Water Works Association and Water Works Manufacturers Association respectfully report that this body has received invitations to hold its Convention at the following places: Baltimore, Birmingham, Cleveland, Columbus, Detroit, Philadelphia, Portland, Oregon, Providence, R. I., Richmond, St. Louis.

Of the places listed only three—Birmingham, Richmond and St. Louis—have substantially supplied all of the information requisite for your committee to determine upon the adequacy of the facilities offered, reasonableness of rates, etc. From the viewpoint of the advantages to be gained from increased membership, points of engineering interest, Birmingham and St. Louis more nearly satisfy the requirements of this Association.

N. S. Hill, Jr.
Theodore Leisen
J. M. Diven,
} *American Water Works Association Committee.*

D. F. O'Brien,
Jas. H. Caldwell,
Chas. R. Wood,
} *Water Works Manufacturers Association Committee*

The several cities were placed in nomination in short speeches by their respective advocates, and on the second ballot the choice fell to Richmond, Virginia, that city receiving a majority of all votes cast.

TRIP TO KENSICO DAM

For Wednesday afternoon the Department of Water Supply, Gas and Electricity, the Board of Water Supply of the City of New York, and the active members of the American Water Works Association in the New York Section territory, tendered to members and guests and the ladies a trip to the Kensico Dam.

A special train left the Grand Central Station at 1.30 p. m. for Valhalla Station on the Harlem Division of the New York Central Railroad.

While the weather conditions were not all that might have been desired, the afternoon was spent pleasantly in this manner.

DISCUSSION

INTERPRETATION OF WATER WORKS ACCOUNTS[1]

BY MARK WOLFF[2]

MR. ALLEN HAZEN: Mr. President, this paper takes up a number of different subjects. We are indebted to the author for his clear forms for stating the principal accounts in a water works system.

In the matter of computing the value of fire services a subject is introduced that is entirely foreign to the bookkeeping end; and while the presentation is interesting and the raising of the rate in the particular case mentioned is certainly commendable, the speaker is inclined to take issue with the author on the method of computation. As he understands it, the author has estimated the cost of furnishing water for all other purposes, and then subtracts that amount from the entire cost of the actual service and in that way arrives at the supposed cost of the fire service. It seems, if you will permit the comparison, that that is exactly comparable to going to the Grand Central Station and asking for a ticket to Albany and demanding that the price of the ticket be determined by the difference in cost to the railroad of running the train because of one's presence on it. Is that not a comparable proposition to figuring the fire service as it is done by the author? There are other considerations that might properly be taken into account, and that were taken into account in the report of the committee of this Association which reported several years ago, which report will be found in the proceedings.

MR. F. T. KEMBLE: It would seem that the percentage allowed to fire protection is altogether too low. The Suburban Fire Insurance Exchange, in fixing the rate for insurance for this section, demands that water companies have a pump station equipment and piping of capacity of five times the maximum consumption.

[1] Published in June, 1916, JOURNAL, Vol. 3, No. 2, at pp. 529–556.
[2] Certified public accountant, New York City.

While consideration of future requirements might induce companies to install mains of a size that would meet this condition, certainly a large part of the pumping equipment and boilers would not be of the size they are, but for the fire protection demand. It would seem that that item might be further considered.

Mr. W. E. Miller: The speaker may have misunderstood the paper in this respect, but it was his understanding that the method of determination of the value of the fire protection service, as stated in the paper, was a quotation from a paper by Mr. Wilcox; and he also desires to take issue with Mr. Wilcox with regard to that method of determining the value of fire protection service. It seems to be making the fire protection service a matter of secondary importance. If there is any difference between the importance of the fire hydrant service and general domestic or commercial service, the fire protection service is entitled to the first rank. Some plants have been built for fire protection service purely, more of them have been built purely for fire protection service than for purely commercial service; and even in a good many instances where they have been built for the combined service, there is evidence that fire protection was the immediate necessity. For example, the city of Milwaukee had no water works until about 1872, and the United States census of 1870 gave the city a population of more than 70,000. These 70,000 people had water for ordinary everyday use, but they realized that their insurance was too high and that they could cut the cost of their insurance rates and reduce their fire losses. Many water plants have passed their first year or two with but little revenue outside of their hydrant rentals. So it seems that you have in these facts strong evidence that fire protection service is of primary importance. Therefore, the only reasonable and equitable basis for apportioning the expenses, including fixed charges and depreciation, is the relative expense of each kind which would be involved in furnishing the two kinds of service from two separate plants, each designed for its own class of service. That, however, is hardly in line with the subject of the paper, which is primarily one of accounting.

Mr. Mark Wolff: The quotation from Mr. Wilcox' article on fire protection and the chart illustrating the fire protection income account of the Queen County Water Company were inserted in this

paper for the purpose of emphasizing how important it is to have a proper classification of accounts available in rate cases. One of the elements entering into the cost of fire protection, as shown in diagram 9, is the portion of the operating expenses attributable to fire protection, and unless expenses are shown on the books in sufficient detail it is very difficult to satisfactorily apportion this cost between domestic service and fire protection. The problem of estimating the cost of fire protection does not pertain exclusively to engineering; accounting certainly has something to do with it.

The speaker also agrees with the previous speaker, that had we figured the cost of fire protection separately, that is, figured what it would cost to erect a plant solely for fire protection, and also what it would cost to erect a plant solely for domestic service, as was done in Wisconsin, and then apply the percentages as between the one and the other, we would in this particular case, have arrived at a greater percentage of fire protection chargeable to the city of New York. However, the method outlined was not intended to be a general method, it was only the method used in the particular case of the Queen's County Water Company, which was not built for the purpose of furnishing fire protection primarily; the furnishing of fire protection was only incidental. The company was organized to serve private consumers, to render domestic service, and the fire protection in this particular case was only incidental. The company had some difficulty collecting its bills, at the increased rate, from the city, because of the finance department not agreeing with the deputy commissioner as to the method of computation. The finance department thought it ought to be considerably less. They thought there was no reason for an increase of 300 per cent; so that although conservative methods were used we were unable to satisfy both sides.

Mr. W. Z. Smith: Will the author of this very interesting paper state whether there was any account kept of the services rendered to the health department, that is, street washing and sewer flushing, which in some cases is a very considerable item? Also whether there was any reason why that should not be incorporated in the system of accounting illustrated?

Mr. Mark Wolff: The company charged the city for furnishing water to the public schools; it did not charge the city as a

separate item for flushing the streets. That payment was covered by the fire protection item.

Mr. C. B. Salmon: Along the line of Mr. Miller's remarks there are important additional reasons for charging the municipality with the cost of the public fire service, and charging the water users only with the cost of the domestic service. For example, a nonresident owner of a large business block may not be paying any water tax, but he does receive a very large benefit in the reduced fire insurance premium on his property due to the excellent fire protection afforded by the water system, and that reduced fire insurance cost on his property is being partially paid by the individual services being charged in excess of what they would be charged if the municipality paid its just share of the expenses of the public fire service.

The question is a very important one and is becoming more so in valuing utility property before the state public service commission as to what per cent the municipality shall be charged for its fire protection, and what per cent should be charged the domestic service in establishing rates. The public is becoming very sensitive on this point because in many cases it is bearing the greater part of the fire service that the city in general should pay, and the benefit is going towards reducing premiums on insurance of many property owners who bear no part of the burden of the water service.

As Mr. Miller has intimated Wisconsin has taken and adhered to the most correct principle for adjusting rates as between the municipality and the domestic service, and in many cities, especially those having twenty to fifty thousand population the fair share of the municipalities' burden of a water system has been found to be from 35 per cent to 50 per cent of the total amount of the operating income.

An additional reason is that the public fire service often protects the private residence property of many people who do not take water or pay anything for it, but their property is protected from fire; and in so far as the municipality does not pay its full share of the cost of the public fire protection, the water consumer is helping to pay for protecting the nonusers' property from fire, except in so far as his taxes, which in this case do not cover all the cost of the fire service, pay a part.

The fair and proper rate chargeable to the public fire service is becoming more and more important because if not properly charged

against the municipality, it will become a continuing basis for quarrels with respect to domestic rates. On the other hand, the domestic service could be lowered and the individual get water at a much less rate if the municipality paid its fair share of the public fire protection. It would also lessen a great many annoying disputes and complaints arising from supposedly too high domestic rates.

The public fire protection service should be paid by the municipality and figured on the basis of what it would cost the city to build and operate a water works system for fire and public service only.

Mr. Wolff in his accounting does not make any charge in the office expense for the items of collection, but admits that when rates are raised it causes considerable trouble. Those who have had the collection of fire hydrant rentals know that this is often one of the biggest expenses that fall on a private company, often leading into extensive litigation. As to water furnished to public schools and for sewers every one of those departments should certainly pay for the water they use as the service is a public one. If the municipality is conducting the public schools it should pay and if the schools are conducted by a school board they should pay. Water for flushing sewers and sprinkling streets should be paid either by the municipality or the board of public works, which in either case would come through general taxation. All of these services put together and joined with the fire service would reduce the rate to the consumer and relieve the public as well as the utility of a great deal of agitation and costly litigation.

Mr. F. T. Kemble: One point that Mr Wolff made is of great interest to all of us who are connected with private water companies; that is the item that water charges become a lien on the property. Anything that will help us towards collecting our charges at times of change of ownership will be of great service. At present we are stuck every time property is sold under a foreclosure, while with an ordinary change of ownership, which we may, or may not be posted about, it is a very difficult matter to make the retiring owner give up. It seems that Mr. Wolff's suggestion in that matter might well be emphasized.

DISCUSSION

PUMPING MACHINERY, TEST DUTY VERSUS OPERATING RESULTS[1]

By J. N. Chester

Mr. J. N. Chester: After having written the paper, in the preparation for the cross-examination which he expected might come after its reading, the author went to the expense of sending a man around the country to get some results, which results when obtained tended to weaken his faith in the statement that the steam turbine, as a power producer has made in the past five years more rapid strides in economy than any other type of steam motor, and many of us will live to see it almost entirely supplant the reciprocating engine. The author does not like to use a turbine under 250 to 300 h. p. Mr. West of the Bethlehem Company has given permission to quote him as saying that in that last statement he was in error, that instead of the vertical triple being crowded off the map by the turbine-driven centrifugal, it would be pushed the hardest by the internal combustion engine driving some type of pump. That of course takes us back, we might say, to the field of that type of unit. The author has limited it to one million gallons, and is using it in several plants of a much greater capacity, but in the natural gas fields. If this paper could go further as to all conditions we might considerably broaden the use of the gas engine. The author is not partial to the gas producer gas engine driven plant, except for some remote conditions, and it must be realized that, as stated in the paper, there are many things that may change the curves so as to show different results. The results depend as much upon the man as upon the machinery.

President Hill: The chair does not know of any particular feature of the average water works plant where so complete a lack of knowledge of the fundamentals of design is manifest as in the pumping station.

[1] Published in June, 1916, Journal, Vol. 3, No. 2, at pp. 493–503.

Mr. W. F. Wilcox: There are so many factors that enter into the proper designing and operation of a pumping station that it would be difficult to undertake to discuss all of them; the speaker will not even undertake to discuss the theoretical determinations arrived at; but will make a few remarks which may be of some benefit to the man who wants to improve pumping station conditions without getting all muddled up; but the speaker can say a few things to you with safety. One is that the greatest loss in the operation of a pumping plant is due to the fact that it is considered as a whole when it should be considered under its several different heads.

The first and most important danger is the lack of conception by those using it that the steam engine is a heat engine. They think that the steam runs the engine like water runs a water wheel; but that is not the fact, because although the steam pressures may be equal, the efficiency obtained will vary in relation to the heat. Therefore, the most valuable instruments which any man can use in a steam plant are a U tube and a thermometer. With those two instruments one can come nearer getting at the disease with which the plant is afflicted, and explaining the remedy to the operating engineers and firemen than by any other known means. When installing or testing a new engine, put thermometers in the pipes where the steam enters and leaves the engine, the controlling points, and thus ascertain the heat that has been used between those two points in the test, this being the utmost which can be approached in every-day operation.

The plant may not be large enough to have all the appliances for testing gauges, and operators must have the "knack." Many men have not the "knack," and that is the reason they do not succeed in life. The same thing applies to a pumping station.

The thermometer is one of the most valuable controls, because the engine is absolutely a heat engine. If you will, when you go home, look your pumping station over and determine by the use of thermometers the best heat results that you can get in the operation of the engine, then determine what your load factor is on that engine, you will find that the load factor will vary the economy from day to day. The reason that operating statistics do not conform to test conditions is that the load factor varies all the time in water works; that is more nearly true of a plant under 5,000,000 gallons daily capacity than with a plant of greater capacity.

Assuming that pumping plants are properly designed, if you will check your engine by a thermometer and by your load factor you can determine what is the best daily result that you ought to be able to attain. Separate your engine and boiler accounts, no matter how small your plant is. The speaker has tried CO_2 recorders, pyrometers, and many other instruments and they get firemen so mixed up that they do not know where they are at. Put an ordinary U tube on the furnace, and you can show your fireman how to keep his fires in good shape, you can show him how to regulate the draft; and you can come nearer developing your fireman into practical usefulness than by any other plan, unless you have a scientific man on your boiler plant all the time.

The speaker had a scientific man at the pumping plant, but to educate the men he had to use a U tube, which costs about fifteen cents. There are some good old rules of thumb that are right handy to have on your desk, rules of thumb that experts laugh at, but if they will figure them out they will find that they are not far away from the best scientific practice. Take the number of B. t. u. in the coal, multiply by 6, point off four figures, and you will get approximately your evaporation; for example, take 13,000 B. t. u., multiply it by 6, that gives you 78,000. Point off four figures and you have 7.8. Now with 13,000 B. t. u. coal, 7.8 is a pretty good result.

A good many people think they are getting a uniform temperature of 200° F., and they are at the time they look at the thermometer. A recording thermometer, costing about $50, will show the temperature at all times, and will prove a good investment.

The actual cost of operation every year ought to be about uniform in any plant. The cost of boiler h. p. generation varies according to the coal cost. In a plant of 500 h. p. you ought to get a cost of operation inclusive of fuel of $2 per h. p. In a plant of 100 h. p. to 200 h. p. if you run as high as $3 it is not excessive. You have to use 500 h. p. to obtain the $2 figure. With a 1000 h. p. plant you ought to get the cost down to about $1.50, or a little less; when you get up to 2000 h. p. you ought to get the cost down below $1; when you get up to 10,000 h. p. you ought to get it down to about 50 cts.

If you will take these little suggestions, or "rules of thumb" and apply them in the daily watching of your boiler plant they will indicate the points which must be followed up, and you can follow them up as closely as you wish.

Mr. Chester spoke of the friction in the steam pipe. There is nothing that is worse confounded than friction in a steam pipe. The modern practice is to increase your velocities. A great many people seem to think that steam pipes are too small. If the velocity in your steam pipe is for ordinary saturated steam 3000 feet, you will have a very good velocity. Getting up into super-heated steam, you can go up into 6,000 or 10,000 feet.

The pipe covering is a very valuable asset, and should be carefully attended to. But go back to that old thermometer, stick it into the pipe again and it will tell you what the temperature ought to be.

Mr. John W. Alvord: Every year we have a valuable paper from Mr. Chester, and he gets more and more mellow, and less and less exact in his statements, which to the speaker's mind is a great advantage. He has presented us some very valuable prospectives, if they might be called so, with regard to station economy; but his characterization of the pump salesman was particularly enjoyed, it was a reminder of the days when he used to sell pumps.

Mr. Allen Hazen: This is one of the best papers ever presented to this Association. It is difficult to understand why the author stopped with pumps. The conditions that are so well described relating to the sale of pumps exist equally for other kinds of equipment.

Mr. H. G. H. Tarr: Mr. Chester's valuable paper brings up many memories. He was one of the speaker's assistants in the pump selling business.

However, listening to his learned paper is like sitting at the feet of Gamaliel. The speaker often looks with great pride to the boys that have graduated under him, for instance, Foster, of super-heater fame; Primrose and Nutting, his able associates; Swanhausser, Chief Engineer of the International Pump Co.; Webster of Babcock & Wilcox, and many more of them, who have made their mark in the engineering world.

It is curious how much more respect one has for John Chester when bidding on his specifications for a Pumping Engine, than he had for him as a young engineer, promising as he was.

Having been in this game for a long time, the realization grows

stronger with the years that engineering is simply tying up good practice with a dollar.

As an illustration, a New York banker wanted an engineer for a certain piece of work, and it was very important that he should get one competent and experienced. The speaker asked him smilingly, "Why don't you employ So-and-So?" He replied, "Why don't I? Why he knows no more of the relation between engineering and the dollar than my boy ten years old." There was a new thought; and when conducting engineering enterprises try to keep it in mind, and constantly hitch up that relation between engineering and the dollar. Is it not true of water works engines, stationary engines, in fact, all the great economic enterprises, that you must hitch up the relation between engineering and the dollar? And there is no example in the world where it is so forgotten and ignored as in the relation between the boiler and engine.

Thermometers, and that kind of thing, of course, are essential, but don't forget the human element, especially in your pumping station. The speaker has gone lots of times into engine houses where he did not want to criticise, because he wanted them to keep their engines in especially good order, and they would tell with great pride what they were doing, on an assumed evaporation; then in the boiler room he had seen them chucking in the coal, paying no attention whatever to economy of the boiler. In many cases, the engineer of the old days seldom went into his boiler room.

Here is a trade secret; a pumping engine builder employed a man by the year, and gave him good pay, whether he worked or loafed, and that man always did the firing on every test made of that builder's engines. The rest of the time he was supposed to sweep out the shop, but he did very little sweeping. That man could go into an engine room on a test and get ten per cent more out of a boiler than any other man the speaker ever saw. How did he do it? He had the "knack." He was originally an old steamship fireman, and that is where he got on to the "knack," firing on a steamship where at the end of the voyage they gave the fireman a bonus on coal saving. Would not this be a good idea in a water works station? Watch your firemen, and give them some incentive. Train your men so that they will watch every ounce of coal that they put into the furnace, and it will do more good than thermometers. Not condemning by any means scientific efficiency, the speaker has found, after long years of experience, that the best results are obtained in the handling of a

pumping plant through careful watching of the performance of the human element.

It is admirable and essential that your men should keep the engine bright, essential that they watch the steam consumption and those details, for that is part of the efficiency of this same human element and so, have your engineer, your fireman, your wiper—every man fall in and see to it that individually the best results are obtained.

Mr. Harry Ellsworth: This paper appeals to the speaker very strongly, as it should to every man who has the responsibility of the operation of a water plant. There has been a growing demand here for more papers of a practical nature; and Mr. Chester's papers always possess that characteristic.

The speaker has been attending these conventions for a number of years, and during that time has heard a good many papers read quoting station duties of from 125 to 150 million foot pounds, in small and moderate sized stations. When hearing those papers read, he commenced to think he was not doing his full duty; so this paper comes as a relief to his mind. Our station is a small one. We have one pump of 4,000,000 gallons daily capacity. The contract duty on which was 140 million foot pounds. This pump has all the refinements that tend toward efficiency, triple expansion, live steam jackets, high duty compensating cylinders, etc., and on test it did develop a duty in excess of the contract duty, considerably in excess of it, a duty, of course, based on 1000 pounds of steam, yet it has failed in maintaining this duty in every-day operation. The results have been disappointing in that respect. It was not long before we found that there was a wide difference between actual every-day operating conditions and the conditions under test. The first thing that the speaker discovered was that a steady steam pressure is conducive to high efficiency. He also learned that the handing to the fireman of a five dollar bill was conducive to a steady steam pressure, this course being perfectly justifiable on the part of the man who was making the test, but we cannot afford to do that under every-day operating conditions.

From another pump the contract duty of which was 100 million foot pounds under every-day working conditions we are getting a duty of 50 million foot pounds per hundred pounds of coal. From his experience the speaker feels that if we get an every-day station duty of one-half of the contract duty we should be satisfied.

Mr. Dabney H. Maury: Of course we have all enjoyed exceedingly listening to Mr. Chester. He is always a treat. In this particular thing he is of course almost at his best, because he is talking on a subject that he thoroughly knows and in which he takes a keen interest. Mr. Chester is a man after the speaker's own heart, in that, while we will not go so far as to say that he seeks a scrap, yet he prepares carefully for a scrap; and would know a scrap if he saw it coming down the road, and would be pretty nearly ready to meet it.

When in the tropics the speaker learned for the first time why a dog had a tail; he never knew just why a dog had a tail; had considered it a sort of belated smile which finally started on the other end; but did not quite see any really useful purpose in the dog's tail. Down there, going out with some old hunters to look for tapirs and other wild animals, which we did not get, he was told that the reason the dog had his tail was that he could feel around behind him and find a place to back out when the enemy charged upon him. Now Mr. Chester's qualifying comment on his prophecy as to the turbine has shown that he is fully equipped in that regard. We must endorse that as we do all his other statements.

Mr. Samuel B. Applebaum: The speaker will make a few remarks which will interest the members regarding one source of loss of heat between the boiler and the pumping engine which Mr. Chester has not mentioned. The loss due to the scale in the boilers is referred to, having in mind a particular pumping station in Springfield, Ohio, where surface condensers are returning to the boilers from 80 to 90 per cent of all the steam evaporated. The 10 to 20 per cent of raw make-up water was sufficient to cause a heavy scale in the boilers. Of course, no one knew exactly how much loss of heat that scale was responsible for. It was only after a water softening plant was put in and a test made of the apparatus for a few months, that it was possible to determine the great reduction in the cost of pumping which resulted from the elimination of scale. The water softening plant has now been in operation over one year; and a test was run for the months of March and April, 1916, comparing the coal burned on the grates with that which was burned during the same two months of the year previous. It was found that about 20 per cent of the coal was saved by softening the water and eliminating the scale. There were no other factors, such as load factor, etc., to be taken into consideration because the amount of water pumped

was the same within 2 per cent during both periods compared, and the grade of coal and labor were the same in both runs, thus eliminating all the various factors that have been brought up that might be of influence.

The duty of the pumping engines based on 100 pounds of coal increased from 60 million foot pounds in 1915 to 80 million foot pounds in 1916. The cost of pumping was therefore reduced about 20 per cent by the installation of the Water Softening Filter.

Mr. J. N. Chester: Just one remark in reply to the comments of Mr. Wilcox, who said that thermometers will tell you the losses in the steam pipe. If the steam is not super-heated, unless the pressure drops in the line, there will be no drop in temperature regardless of what your condensation or heat loss may be.

DISCUSSION

PREVENTION OF WATER WASTE ON RAILROADS[1]

By C. R. Knowles

Mr. J. M. Diven: In Charleston, S. C., the superintendent of a railway asked the Water Company to repair a number of hydrants in the railroad yards, complaint of their condition having been made by the fire department. The fire department requested very prompt action, as the hydrants were in the cotton yard and cotton yards are very bad risks. The work was promptly done. About a week later a very peremptory message was received wanting to know why the hydrants had not been repaired. The railroad superintendent was told that the repairs had been made promptly. On going over the yard with him it was found that the hydrants had been tampered with after the repairs had been made. The nuts on three or four of them were filed square so that a monkey wrench would fit them. Further investigation disclosed the fact that the firemen and engineers were in the habit of using these hydrants to wash up when they came in from a trip. They would turn the water on at the fire hydrant and make their toilet there instead of at the round house. What the amount of waste was in that way we had no means of ascertaining, because this was fire service and was supplied without meters.

Mr. C. R. Knowles: The most dangerous form of waste that we have to contend with is in the use of water closets, automatic flush tanks and other services with direct connection to sewers. In this connection we made an investigation of the toilet facilities at one of our terminals where we have something like 180 urinal flush tanks and 290 stools which are equipped with automatic valves flushing direct from the main. In making a survey of the situation it was estimated that we could bring about a saving of at least $500 per month. Some of the local officers thought it was a crazy state-

[1] Published in June, 1916, Journal, Vol. 3, No. 2, at pp. 356–363.

ment and cheerfully told us so, but at the end of the first month or so the saving proved to be some $700.

We have recently added a large number of toilet facilities at this point, but close supervision has kept the consumption of water lower even than that with the original installation.

We meter our own supply where it is pumped with our own facilities in some instances where it is desired to correct a waste. Meters are of particular value where we have joint facilities in connection with other railroads. We expect the saving that will be made at one point, where we put on meters, to pay for the meters in a year's time, because the use of the meters cuts down the consumption and keeps it where it should be.

DISCUSSION

PRESSURE FILTERS[1]

By Harold C. Stevens.

Dr. W. P. Mason: The speaker has always been prejudiced against the pressure filter, although he cannot help feeling that his prejudice is not well founded. It may be merely because he likes to see "the wheels go round" that he prefers an open filter. It must be acknowledged that the pressure filters have a large field of usefulness, although the speaker never liked them, though he has seen excellent results from such filters and they are unquestionably of smaller cost; but, as before stated the desire to see the inner workings of a plant is the only reason the speaker can offer for preferring an open filter.

We are looking forward to some day putting in a filter at Troy, and can easily understand how a pressure filter there would be better for our conditions than one of the ordinary gravity type, as we have several sources of water supply, three in fact, each of them drawing from a different level. Undoubtedly we would be better fitted with filter accommodations if we put in the pressure type.

Has the writer of the paper any preference with reference to the methods of getting rid of the air when he uses the air wash? How are you going to get it out of the filter?

Mr. Harold C. Stevens: The waste water pipe, arranged to discharge into an open funnel, is probably the most usual means for releasing air from an air washed pressure filter. A separate valve can easily be provided for emitting the air, where the waste water pipe is not adaptable, and it would not appear to be a difficult matter to make this valve automatic.

Mr. C. Arthur Brown: How is the proper degree of coagulation obtained in a pressure filter? In some pressure filters there has been difficulty getting regulation of coagulation within the shell; being broken up when it is introduced into the filter beds, it does not

[1] Published in June, 1916, Journal, Vol. 3, No. 2, at pp. 388–397.

hold so well, apparently, as in the gravity type where the coagulation is brought into and onto the bed without so much breaking up of the particles.

Mr. Harold C. Stevens: The preferable way, where feasible, is to provide a separate coagulating basin, such as is used with a gravity filter.

Mr. C. Arthur Brown: In that case you would pump from the settling basin through the pressure filter?

Mr. Harold C. Stevens: Yes. There is no doubt that the coagulum is broken up by pumping, but to the speaker this is not a serious objection. The efficiency of the pressure filter does not seem to depend so much upon the condition of the floc as does that of the gravity filter. The speaker has not yet learned of an instance where trouble from this cause has arisen with pressure filters.

In some cases a reservoir higher than the filters affords opportunity for coagulation and the delivery of water by gravity without severe agitation. It is well, nevertheless, to avoid the breaking up of the floc as much as possible.

Mr. J. W. Ledoux: The speaker has read with interest the paper of Mr. Stevens on pressure filters, and notes his favorable opinion regarding their application and suitability. His conclusions are no doubt strengthened by the large amount of operating statistics that he must have obtained in various parts of the country.

There has been a considerable feeling against pressure filters, in some cases possessed by engineers who desire to maintain a reputation for adhering to the most conservative and popularly accepted design in water works purification. It is rather disappointing that the author did not show the results of several important installations, which he no doubt has in his possession.

The main advantage of pressure filters is their applicability in many cases where by their use low service pumps can be eliminated, with a consequent material reduction in cost. In the horizontal type, it is not so easy to design a satisfactory strainer system as with gravity filters or the vertical type of pressure filters, which is due to the curved sides and ends of the horizontal filters. In fact, this is the only valid objection to pressure filters. The strainer system of

any filter plant has not, by any means, reached perfection, and any feature that adds to its difficulty is objectionable. Nearly every experienced water works engineer has designed at least one strainer system, with which he later becomes more or less disappointed, and this applies not only to pressure but to gravity filters.

It would seem that the simplest and most satisfactory strainer system would consist of a manifold, with pipe connections having $\frac{1}{4}$ or $\frac{1}{2}$ inch openings pointing downwards, the whole being surrounded by a layer of broken stone or large gravel graduating upward to small sizes, the entire layer being as thick as possible, the upper portions of this layer to be high in specific gravity as compared with the sand.

Such material as lead shot is expensive, and engineers generally are content to use such graduated gravel as is readily obtainable in the market. The consequence is that unless some artificial method is adopted to keep the gravel in place, it may at some time be displaced. It is a well known fact that particles of small size are lifted in inverse ratio to some positive power of their diameters. For instance, particles of lead $\frac{1}{32}$ of an inch diameter would be lifted with an upward velocity that would not move ordinary gravel $\frac{1}{4}$ inch in diameter. The speaker has never made any investigation as to whether particles of a spherical shape would be more liable to remain in place than those of an angular shape. Ordinarily, however, if the water has a uniformly accelerated velocity, and the bed of gravel is of normal condition, it will remain in place very satisfactorily, and thereby prevent the sand from dropping down into the interstices. One of the great difficulties is due to accumulations of air which suddenly shoot up through the bed, displacing portions of the gravel, and temporarily destroying that part of the strainer system.

More or less successful attempts have been made to separate the gravel from the sand by means of a perforated plate held down by wire fasteners to the lower manifold system. Any device of this kind that will keep the gravel from moving at local points is of value.

There are a large number of brass strainers any one of which may give first class results for a considerable period of time, but they nearly all deteriorate under certain conditions, whereof the quality of the water probably is the cause; and even pure copper is subject to the same trouble.

Objections have been made to pressure filters on account of their not being readily adaptable to the use of rate of flow controllers,

but there are controllers on the market which are used very successfully with pressure filters; and today there is no difficulty in equipping these pressure filters with rate of flow controllers, loss of head and rate of flow gauges, and even sterilizing devices. One plant with which the speaker is familiar has pressure filters working under pressure from 130 lbs. to 150 lbs. per square inch. The filters are washed at the rate of 15 to 20 gallons per square foot per minute by gravity, the water being taken from a wash water standpipe located some 40 feet above the top of the filters. After the water passes through the filters it goes through a mile of pipe to the distributing reservoir located above the highest point of the town. Liquid chlorine is discharged into this effluent pipe on the town side of the filters by means of a small pump having a capacity of about 2½ gallons per minute, and the discharge of this small pump is diluted to about one part of chlorine to 10,000 parts of water, or about 100 parts per million.

In conclusion the speaker is of the opinion that the gravity type of mechanical filters is generally to be preferred:

First, because they are cheaper to construct.

Second, because they are more readily accessible for repairs.

Third, because they are adaptable to the economical utilization of floor space.

On the other hand, the water purification results are exactly as good with the pressure type, and where the avoidance of double pumping is an important desideratum, engineers should not hesitate to use pressure filters.

In regard to the coagulant and the difficulty about the pumps dissipating the floc, the speaker is positive there is nothing in that at all. The results are equally good so far as the sulphate of aluminum is concerned. In one plant having a capacity of 5,000,000 or 6,000,000 gallons per day the sedimentation basis is of about 10,000,000 gallons capacity. Aluminum sulphate is fed into the basin directly, from which the water is discharged into the suction well and afterwards pumped through the pressure filters. Very accurate statistics are kept of the plant, as to the bacteria presence of B. coli and everything pertaining to a filter plant. The raw water shows an average of about 1000 bacteria per cc.; and the final filtered water shows an average of about 15; and that is the result of only four or five years' continuous operation.

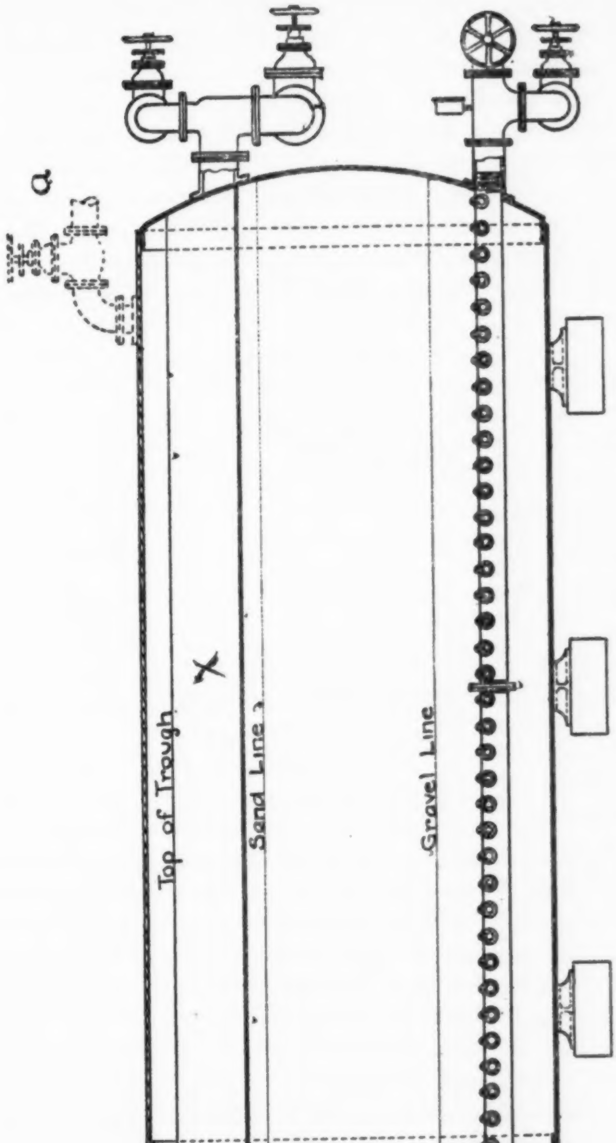
These filters have been in use for thirteen years. On the same

water system there is a modern type of gravity filter, and the most complete apparatus for producing efficiency and comparing results as to turbidity and bacteria. While the raw waters are substantially the same in quality, the difference is slightly in favor of the pressure filters; but that difference is so slight that it is considered insignificant. It simply shows that with pressure filters under proper management excellent results are easily obtained. Where there are other things of importance, such as the avoidance of low service pumps, the speaker would not hesitate for a moment to put them in, but for all types of filters the sedimentation basin should never be dispensed with.

Mr. J. N. Chester: The speaker has looked upon pressure filters for purifying water very much as he does the air lift for raising water; namely, as a good thing to get along without, but a fine thing to have when you can do no better. It certainly then follows that he prefers the open gravity mechanical filter to the closed or pressure type, and in this preference he believes he is supported unanimously by the state boards of health or other bodies burdened with the duty of approving plans for filter plants intended for public water supplies, and the New York Conservation Commission has adopted a clause in its mandates or approvals which it thinks precludes pressure filters. It is, that a sight gravity feed must be provided for the coagulant.

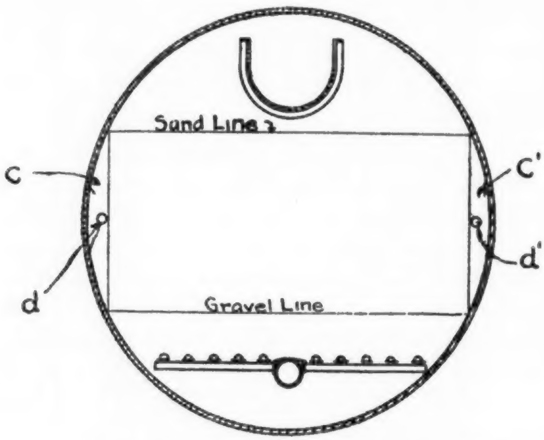
The speaker has never discredited or looked askance upon pressure filters he has encountered, installed and had in service, nor does he deny that good results can, with careful operation, be obtained; but has found that the difficulties of operating, especially on western waters are greatly multiplied over what they would be with gravity filters. Most writers dictate that a sedimentation basin shall be a part of any filter plant intended to clarify or purify, the capacity of which must be from one to four hours' quiescence period, and to provide this quiescence or sedimentation period is extremely difficult in connection with pressure filters; besides to pump coagulated water lessens the filter efficiency, since it breaks or almost pulverizes the floc and renders it less apt to be arrested by the sand.

As Mr. Stevens has shown, filters exceeding two hundred thousand capacity per day should be built cylindrical and placed horizontally, which adds to the difficulties. The cut used by Mr. Stevens was similar to the cut herein incorporated, with the exception that no



LONGITUDINAL SECTION OF PRESSURE FILTER

wash trough was shown, which represents the majority of horizontal pressure filters today in use. Now let any practical filter operator imagine the process of washing begun without the trough (x), but that the influent is admitted through the valve and pipe shown in dotted lines at (a), and imagine the path of a particle rising at the surface of the sand at (b). Experience led to the conclusion that cleaning the rear of such a filter was a practical impossibility, the result of which was the introduction of the first wash troughs used in pressure filters at East St. Louis, Illinois, which feature has been copied by some of the filter companies since that time.



Cross Section of Pressure Filter

Another feature hard to overcome is the inability to wash the segment (c) and (c') shown in the cross section of the cylindrical filter. To overcome this it was found necessary to introduce 2 inch horizontal pipes (d) and (d') with perforations at such an angle that when water was introduced in them under pressure, it would agitate and remove deposits in these segments. Mr. Fuller can testify to such conditions at Hornellsville, N. Y., nearly twenty years ago, and in nearly fifty similar filters the speaker has since examined and labored to make efficient, the same difficulties have been found to be overcome as above described.

The speaker does not agree with the author of this paper that a good pressure filter plant can be built for $12,000 per million gallons, or that the average cost of gravity filter plants is $20,000 per million.

If as well equipped, the cost of the pressure plant will equal the cost of a similarly well built gravity plant. In either case you will get just what you pay for.

The speaker further takes issue with the author of this paper as regards the cost of pumping through pressure filters being greater, due to the increased head, than if the gravity plant was used and twice pumping employed, for the energy required to overcome the slight additional head is far less than the thermal losses due to twice pumping which the gravity plant requires. This of course is in favor of, and the only reason, from the speaker's point of view, why pressure filters should be seriously considered, and then only when settling facilities may be practically dispensed with.

In conclusion will repeat that it is admitted that, with the proper installation and care in operating, as good results may be obtained from the pressure filter as from gravity. No reason is apparent to look askance at or dispense with a pressure filter plant in operation, but the speaker is not enthusiastic, under 95 per cent of the conditions found, for the installation of pressure type filters.

Mr. George W. Fuller: It would seem that perhaps the essential proposition involved in this question is whether the water under consideration must be subjected to the process of sedimentation before it is applied to the filters. If not, then mechanical pressure filters under many circumstances are more advantageous than gravity filters. That outcome is the exception, not the rule. When you have to deal with a very turbid water, which, for 10 or 20 per cent of the time throughout the year causes a filter without sedimentation to stagger under its load, then you have to figure with the necessary preliminary treatment, which will allow the filters to work most advantageously. If the local conditions are such that preliminary treatment is essential, then pressure filters may also present themselves for consideration, although they may require double pumping, which this style of filter is supposed normally to obviate.

In the speaker's practice he sees once or twice every year cases where pressure filters are strongly to be advocated as an advantageous means for purifying water. Rate controllers now make them more reliable than was the case in earlier years. At the risk of repeating the views of others, the speaker would say again that, other features and conditions being the same, a pressure filter will give as good service as a gravity filter. It must be admitted that

you have to watch it under rather more disadvantageous circumstances as to the point of observation, but, granting that you have the ablity to observe and record what the actual accomplishments are, then the same degree of coagulation, the same degree of turbidity, the same kind of sand, and the same efficiency in washing will give about the same result with either type of filter. The real question in selecting the type of filter is the significance of secondary pumping and of preliminary sedimentation. It is not necessary to argue that question here. It will have to be figured out in dollars and cents under each set of circumstances.

Mr. F. B. Leopold: There is one phase of this matter that has not been discussed by previous speakers which the speaker considers most dangerous and of sufficient reason of itself without consideration of any others, and there are many others extremely good and important. Pressure filters should not be advocated for municipal sanitary supplies and the reason is the fact that the average engineer in a small town, or water works superintendent of a small town, without considering the laymen at all has no conception of what filtration really is or will accomplish. He usually follows the lead of engineers of standing in the water field, and more often than not, even in this is not a very good imitator.

If, therefore, recognized authorities are found proclaiming as a fact that pressure filters are equally efficient to gravity filter installations, even in the proper limitation, the fact will soon become submerged, and the lower cost and greater apparent compactness and unit completeness of the pressure filter will appeal to the purchaser with the result that there will be a flood of installations of this type which will lead to absolute failure and rank waste of money. This phase should cause us to hesitate a long time about proclaiming efficiency of pressure filters.

As a matter of fact, this very condition, of course, has been gone through in the early development of filtration, and with all refinement that could be possibly put on or attached to pressure filters, their field is extremely limited, and only after the closest investigation of a water supply, and of the condition of this supply throughout the entire year, and with the necessary knowledge of the full limitations of pressure filters that can only be gathered by experience in their use, should they, under any conditions, in the speaker's opinion, be advocated.

There is no question that, with proper installation, proper operation and proper construction, they may be made to give satisfactory results. In fact, there are a number of well known pressure filter plants which are giving, even without the refinement mentioned, extremely efficient results. Nevertheless, these are only the exceptions that prove the rule and while from the manufacturer's standpoint the speaker would be inclined to welcome the use of pressure filters as a more profitable business proposition, as a quicker return on the money invested, outside of this purely selfish consideration and outside of the reasons given above, there are a dozen good reasons why he cannot agree with the writer of this paper that pressure filters should receive more consideration for sanitary supply than they do at the present time As a matter of fact, there are today being installed any number of them, some of them by pretty good engineers too; and some of them by manufacturers who know better, but are compelled by reason of competition to do it, plants which should not be put in, and which will only be abandoned in the course of a very few years, as have hundreds of those that have been installed in the past.

For the builders who do this there is some excuse. They have not opportunities to investigate fully and completely all conditions under which they are installed, but must depend largely on the word of the purchaser as to a very large part of the necessary information to intelligently advise them, and must have in view what the competitor will do also.

For the engineer there is no excuse. He is employed by a city or an individual to advise them what is for their best interests and he is, or should be, paid for the necessary time to fully and completely make the necessary investigations to intelligently advise them.

The speaker does not believe a discussion of the details of construction is of any value here, for the reason that he does not believe that there is any possible method of constructing the pressure filter that will make it a subject for serious consideration except in very isolated instances.

Mr. Dow R. Gwinn: Like Dr. Mason the speaker was once prejudiced against pressure filters. From 1892 to 1901 he lived with a gravity plant on the Mississippi, and came to the conviction that a mechanical gravity plant was the only kind, but when transferred to Terre Haute found the pressure filters there, and had to

overcome his prejudice, the pressure filters being there he had to get results out of them.

Now "the proof of the pudding is in the eating," and the actual results obtained from a pressure filter are what you must go by. Not that a pressure filter will answer in all cases; it depends entirely upon the character of the water that you have to handle. After all, when it comes to the last analysis, the success of a filtration plant depends upon the kind of water that is applied to the filter bed, that is, the condition of it when it is applied.

When they first began building pressure filters a great many years ago, they did not know much about sedimentation. That also applied to the gravity filters. They did not provide sufficient sedimentation for the western waters.

The plant in Terre Haute was first put in in 1889, with no provision for sedimentation, and the results were not always satisfactory, because at times the waters became very turbid and would run up as high as 3000 ppm.; but the most of the year the turbidity would only be about 25 ppm., so that one pump was all that was necessary. In 1891 a large sedimentation basin was put in, in order to get rid of the heavy suspended matter present at times when the river was turbid; the basin was used 25 per cent of the time, one year it ran up to about 50 per cent. Of course, a great deal of fuel was saved on account of the single instead of double pump.

Now, since the first of the year examinations have been made of 10 cc. samples; and out of 152 samples only 8 showed positive for B. coli. During the same period there was only 1 positive B. coli, in the 1 cc. samples, certainly very remarkable results.

On the other hand, the question of typhoid fever mortality would come in, and by the official records the average for the past five years was at the rate of about 25 per 100,000 population. During that period there were only a very small number of fatal cases on premises supplied with filtered water; leaving out the imported cases, and the cases where they used water other than city water, there were only 3.9 per 100,000 population; showing that as far as the results are concerned they can be obtained with a pressure filter plant.

There are some reasons why the gravity plant is better. The speaker, like Dr. Mason, "wants to see the wheels go round;" wants to see the wash water coming up through the filter bed; but in many cases a pressure filter plant can be used to very good advantage.

The Terre Haute results will show what can be accomplished with a pressure filter, and are given here as actual experience with a pressure filter plant, operating on a Middle West river water.

The Terre Haute Water Works Company. Pressure filters, operating results for a five year period, 1911 to 1915 inclusive

	1911	1912	1913	1914	1915	AVERAGE OF AVERAGES
Average turbidity, raw	121	172	115	55	95	111.6
Average* million gallons filtered daily	4.47	4.39	4.92	5.31	4.98	4.81
Average† g.p.g. alum used	2.07	2.36	1.64	1.40	2.14	1.92
Average pounds hypo	......	10.1	9.5	8.4	......	9.3
Cost chemicals per million gallons	$2.88	$3.40	$2.18	$1.69	$1.65	$2.36
Average alkalinity, filtered	180	164	180	170	175	174
Average color, raw	20	28	26	26	30	26
Average color, filtered	13	17	15	17	17	15.8
Average bacteria per cubic centimeter, raw	1147	2530	1767	1250	1637	1667
Average bacteria per cubic centimeter, filtered	63	39	42	65	35	48.8
Average filtration efficiency	94.4	98.4	97.1	95.0	97.8	96.5
B. Coli in raw (daily analyses), per cent of times 1 cc	76.0	66.0	67.4	53.3	68.3	66.2
B. Coli in filtered (daily analyses), per cent of times 1 cc	6.0	1.9	2.2	2.6	2.1	2.96

Note; Above bacteria counts in filtered water include those when filters had growths in August, 1911, and July and August, 1914.

* Not deducting slippage.

† Average price alum per 100 pounds f.o.b. T. H. {1911, $.93; 1913, $.87; 1912, .93; 1914, .84; 1915, $.846

Add labor cost of $.08 per 100 pounds for unloading.

Pressure filters, Terre Haute, Indiana. Chlorine Gas and sulphate of alumina, March 14 to 19, incorporated. Using gas only for disinfection

DATE	KILOWATT	POUNDS SALT	BACTERIA PER CC.		B. COLI 10 cc.	ALUM G. P. G.
			Raw	Filtered		
March 14..........	90	80	1500	40	Neg.	2.20
March 15..........	93	85	1200	30	Neg.	2.21
March 16..........	80	75	1200	11	Neg.	2.00
March 17..........	89	75	900	40	Neg.	1.30
March 18..........	66	75	480	40	Neg.	1.14
March 19..........	92	65	420	15	Neg.	1.54
	510	455	5700	176		
Average...........	85	76	950	29.3		1.73

Hypo and chlorine gas in connection with sulphate of alumina. Average bacterial results

DATE	BACTERIA		B. COLI—FILTERED			
	Raw	Filtered	1 cc.	Number times		Per cent times positive
				Positive	Negative	
January...........	6850	67	1 pos.			
			30 neg.	3	28	9.7
February.........	2930	45.4	29 neg.	3	26	10.4
March............	1520	31.3	31 neg.	0	31	0.0
April.............	1800	18.6	31 neg.	1	29	3.3
May..............	990	14.3	31 neg.	1	30	3.2
Average...........	2818	35.3				5.3

Terre Haute, Indiana, typhoid fever mortality

YEAR	DEATHS			POPULATION	RATE PER 100,000 AMONG CITY WATER USERS	RATE PER 100,000, TOTAL
	City water at residences	Well water only at residences and imported cases	Total			
1911			17	58,000		29
1912	3	13	16	58,000	5.2	27
1913	2	13	15	58,000	3.5	26
1914	3	12	15	60,000	5.0	25
1915	1	12	13	60,000	1.7	22
Total*......	9	50*	76		15.4*	129
Average*....	2.3	12.5*	15.2		3.9*†	25.8

* Four years.

† It is estimated that 60 per cent of population use city water so that this figure, 3.9, would correspond to a rate of 6.5 if 100 per cent of the population used.

Mr. Robert E. Milligan: Mr. Stevens' paper opens up a subject that the American Water Works Association, and through them the water works world, will greatly appreciate when the matter is presented and full data supplied.

As many of you know, the speaker has had some experience in the purification of water through filtration, and has had some opportunity to examine the gravity and pressure filter plants installed and to note the results from same. He has been peculiarly situated to know the cost and operating values of both types. In endorsing Mr. Stevens' conclusions it is appreciated that these upset many preconceived ideas, and that it is not overstating the matter to say that the advocates of gravity filters have wholly lost sight of the practical phase of the matter. Mr. Stevens' paper is very general in its treatment of the subject, and an intelligent discussion should also be based upon general rather than individual instances, so that the question as to the merit of the pressure filtration plant and its general fitness becomes a matter of common sense following upon intelligent observation as to whether or not water can be purified equally well with the gravity filter as with the pressure filter, and which actually performs the work equally well with the least expenditure of time and money.

After having noted the results from many plants and with an understanding of the conditions under which filtration plants have been installed and are likely to be installed, the results are greatly in favor of the pressure filter. In all probability the attitude of the water works engineer in favor of gravity filters was and is due, first, to the fact that the original filters installed during the early purification period in this country were almost all pressure filters so that the abuses and failures incidental to a more or less crude method became a reflection on a particular class of filter rather than on the general method itself.

Second, until recently the control of the influent and effluent and the proportional amount of chemical under control was absent and only came into successful use through the gravity filter.

Third, the design, sale and installation of the pressure filter, like that of any other complete machine, is not so much an engineering problem within the jurisdiction of the engineer, as it is a direct offer of the manufacturer.

Fourth, the favorable trend of public opinion as to the use of sterilizing agents, following the use of sulphate of copper authorized by the United States Government, made possible a new factor in the purification of water that was wholly inadmissible in the earlier days when pressure filters were installed almost exclusively.

The use of hypochlorite of lime and chlorine following the Jersey City case further prepared the public mind for the direct use of chemicals in destroying bacteria irrespective of any cleansing method. And it may be stated right here that the filtration of water is essentially a cleansing method and that the purification resulting is due to the removal of unclean elements from the water itself rather than to their destruction; while sterilization is a destructive method rather than a removal method. No doubt exists in any of our minds that there is little if any competition between sterilization and filtration, but that they are together a method of completely purifying water. That is the practical side of the proposition.

It cannot be stated seriously that a gravity filter has any advantage over a pressure filter in removing bacteria. It could be and probably will be stated that gravity filters have shown in general a more perfect bacterial removal. To those who regard the matter in this light it should be pointed out that the bacterial inefficiency of certain pressure filters was not due to any inherent weakness so much as to carelessness and ignorance on the part of those controlling

them, who in many cases did not take the question of filtration seriously, but installed the quickest and cheapest method in order to satisfy an ill directed public clamor; but it is a matter of fact that in some cases a half million gallon pressure filter plant was installed on a four million gallon supply and 75 per cent of the water by-passed around the filter, the filter being there only to prove the willingness of the public service company to comply with the demand for filtered water. Happily, conditions to-day are such that the subject is now understood not only by the engineers and the practical water works men, but in a large measure by the general public, so that installations within the last ten years have been honestly advised to meet actual necessity. This, then, means that the same area of filtration will be installed in the case of pressure filters as in the case of gravity filters so that sound conditions may be established and comparisons can be made.

It is well understood now that the devices developed through the gravity filter for the control of the influent and effluent and applied chemical are equally applicable to the pressure filter. It is also true that, having the more or less perfect controls, either method can be installed and equal bacterial efficiency accomplished in the case of the pressure as with the gravity filter. There are several cases in which such good results have been achieved that the use of a sterilizing agent has been virtually abandoned, and while the apparatus is retained it is only to meet some possible emergency due to an extraordinary condition. At Atlanta, Georgia, the use of a sterilizing agent has not been necessary for a great many months, and the pressure filters there installed are giving upwards of 98 per cent efficiency, the actual counts in the last six months in the filtered water averaging in the neighborhood of ten bacteria per cubic centimeter. This particular installation also makes it possible to localize a very great advantage of the pressure filter over the gravity filter, and that is its elasticity in cleansing a much greater quantity of water per square foot of area than would be possible with a gravity filter under similar conditions. It will be interesting to state that the bacterial results just cited have been accomplished at times by the Atlanta plant at twice the rated capacity. In other words, almost a complete cleansing and bacterial result has been obtained where the half million gallon unit of filtration has been operated at the rate of 1,000,000 gallons in twenty-four hours. It is not intended to convey the idea that a filter can be operated indefinitely in excess of its rated capacity

and its bacterial efficiency not be affected. In fact, experience shows that there is a more or less direct relationship between the rate of filtration and its bacterial efficiency, particularly with certain waters. This would now, however, be of little moment where sterilization could be depended upon to correct such variation, provided that the cleansing of the water is assured as well at the higher rate as is the case if the normal rate of 125,000,000 gallons per acre is used. It not infrequently happens that a city through municipal conditions beyond the control of the water department is unable to provide for a rational and steady increase in the productive end of their water works situation. Pumps are in many cases run at a greater speed in order to furnish a greater volume of water even though the efficiency of the pump is affected. Likewise, a pressure filter can be operated during such emergency periods to produce a greater quantity of filtered water, and it is a fact that the loss of efficiency in the bacterial sense where a 100 per cent increase in production occurs is not more than 10 per cent. This 10 per cent reduction in bacterial efficiency can be readily overcome during such emergency periods by the use of a minute quantity of sterilizing agent, such as chlorine. This condition is not similar in the case of a gravity filtration plant.

The pressure filter, while costing more per square foot of area so far as the filtration unit itself is concerned, is cheaper to install because of the elimination of the double pumping scheme and because of the avoidance of the clear water well as an essential part of the filtration project. In many cases reservoirs and standpipes have already been installed and the building of a clear water well is of no particular value so far as the practical operation of the water works system in general is concerned. Where a storage reservoir for clear water is essential it is as much a part of the general water works scheme as any other and is not particularly related to the filtration installation. It will be stated that sedimentation is a valuable and in some cases a necessary part of a properly designed filtration plant. This is quite true, but again it is as easily applied to a pressure filter proposition as to a gravity filter installation, that is to say, if it is necessary. It also rests on its own foundation and its location would in most cases determine in advance the advisability of installing pressure or gravity filters. This is intended to admit that there are conditions favorable to the installation of gravity filtration plants. There are also cases where the pressure filter is not only the most economical but the most practical method of purifying the water, and

in such cases it is uneconomical and inadmissible to install gravity filters. Unfortunately there exists a prejudice which has in some cases compelled the installation of gravity filters, and it is sincerely hoped that Mr. Stevens' paper may open up a discussion wide enough to satisfy the public service commissions, boards of health and engineers that no reason exists for this prejudicial exclusion.

In discussing a subject so many phased as this the character of the water to be treated is of the utmost consequence. For example, there is no doubt whatever that a highly colored water substantially free from suspended matter can be treated to better purpose through a pressure filter without subsidence. There is little or no doubt that in the treatment of waters containing iron under most of the conditions affecting iron waters this is also true.

It frequently happens that in the design of a filtration plant by an engineer retained by a city considerable money is expended on the building and construction work so that the filter can be observed by the operator. If this were of any real advantage it would of course be a good argument against the pressure filter which is enclosed and the operation of which can only be seen through such gauges and sight feeds as may be installed for the benefit of the operator. As a matter of fact, however, the function of a filter is to perform, and its performance can be controlled and observed as frequently as may be desired without resorting to the visualization of the surface water superimposed above the sand bed; nor would the actual observation, even if it were practised, affect the performance or give to the operator any additional safeguard affecting the performance.

Mr. Stevens' article could not have been taken seriously in the earlier days of filtration, but today there is no doubt that with the development of the Venturi tube and the regulation incidental to it a satisfactory control can be established, and the regulation of the pressure filter be made as exact as that of the gravity type.

In the washing devices there is no method satisfactory in the gravity type which is not equally applicable to the pressure type. There is, however, a limitation as to size in the use of the pressure unit due to economical development of the tank itself, it being practically impossible to construct a greater unit than will handle one million gallons in twenty-four hours at the normal rate of filtration. Many water supplies, as, for example, Scranton, Pennsylvania, have several sources, and the pressure filter in such cases would meet a condition that would be extravagant, to say the least, if gravity filters were employed.

So far as the life of the plant is concerned, there are actually in existence in the United States today pressure filters that have been in constant service for thirty years, and the material appears in excellent condition where any reasonable care has been taken of the plant. It is not improbable that a good steel pressure plant will last in all substantial respects as long as a concrete gravity plant. In view of the improvements to be expected it is reasonable in any case to expect that a filtration plant of either type that has served its purpose for forty consecutive years has fully met all the requirements, and the question of rehabilitation, increase or substitution would be substantially the same in either case.

Mr. George F. Catlett: When you bring up the question of pressure filters, you touch a sore spot with the health officials. This is due to the trouble experienced with the numerous small installations of this type that fail to give satisfactory results, and whose usual recommendation is that they are "fool proof" or can be operated with little trouble or attention. The usual idea is that you fill up the alum feed box, set the filter to running, and a pure water will follow. Experience shows that a very poor quality of effluent is obtained. The speaker is very strong in the belief that, even with a plant of 50,000 to 100,000 gallons capacity, you should have an operator who is thoroughly familiar with his purification process.

Mr. Fuller, in his discussion, suggests the importance of basin treatment. The large majority of raw water supplies have considerable quantities of color or turbidity to remove, and for this purpose the basin treatment before filtration is the most important part of the process. The filters will not accomplish the necessary results, and this part of the work should be performed before the water reaches the filters. For this reason it is important, even in the smaller plants, to have this part of the plant developed to the highest stage of efficiency, necessitating competent control by laboratory supervision. Proper basin treatment is not possible in connection with pressure filters, as has been admitted in the course of the discussion.

When we consider this phase of the matter, the speaker has not heard any advantages of pressure filters so far that will offset this serious objection, and compare with results obtained from efficiently designed, adequate coagulating basins, operated by intelligent operatives, and followed by filtration with gravity filters.

The speaker is not in a position to compare costs, and, in a body of this kind with so many water works manufacturers, would like to hear something further from them in this respect. The ideas of health officers are largely based upon quality of results obtained.

Mr. H. C. Stevens: The speaker does not claim that the pressure filter considered simply as a device for purifying water, has any general advantage over the gravity filter, but does believe that a pressure filter plant can be constructed more cheaply, and that, if it is equally well equipped and operated it will deliver just as good water. The figures given are of a general nature and are not based on a specific design, but they have been carefully considered, and they are sufficiently close for a broad comparison.

Mr. J. M. Diven: Mr. Catlett says that he has not heard anything that tells him of any advantage to be derived from pressure filters. Though Mr. Milligan seems to have pointed out several, a case in point might be of interest, a real situation, one where a pressure filter is contemplated and advised. A gravity supply with ample pressure to allow for any loss in the filters; but so located that a gravity filter could not be installed that would not make pumping necessary, thereby greatly increasing the expense of operation and cost of construction. The supply reservoir has sufficient elevation to give the required pressure, allowing for the loss in the filters; but the outlet to the supply conduit is through a pressure tunnel one mile long, and to locate a gravity filter at the outlet to the tunnel would reduce the head more than consistent with good pressure in the distribution system. To filter this supply at the reservoir would make it necessary to install low service pumps to pump to the filters if gravity filters were used. The reservoir is twelve miles from the city and several miles from the nearest railroad, so that coal and other supplies would have to be hauled long distances, at large expense. On the other hand, if the water was filtered by gravity filters near the city the head provided by the location of the reservoir would be wasted and high service pumps would be required to give the desired pressure in the distribution system. With a gravity filter located at the reservoir wash water pumps would be required, as well as the low lift pumps, another item of expense that can be avoided by the use of pressure filters.

The water is low in turbidity, has long sedimentation and would

need no preliminary treatment for filtering by pressure filters. The only possible disadvantage, and this has been carefully considered, is that to provide for fire service, peak of load and other extraordinary demands the filter plant would have to be of greater capacity than a gravity filter having a clear water storage to take care of excess uses. But a careful weighing of this cost with the constant cost of operating pumps, constructing clear water reservoir and the necessary machinery for operating the gravity plant, shows a large saving in favor of the pressure type of filter. No more intelligent attendance would be required with one type than with the other. No municipal filter plant should be left to unintelligent management and operation. Does not this tell Mr. Catlett of a possible advantage in a pressure filter?

Small pressure filter plants are undoubtedly often left to the tender mercies of unintelligent management and operation; but in these cases a gravity type would be impossible, because it could not be operated at all without more attention than can be given to such pressure filters, and, while these poorly attended filters undoubtedly give poor results, they are better than no filters.

Mr. George F. Catlett: Mr. Diven seems to have misunderstood the speaker. Most of us can recall just such instances as he has cited. The Atlanta case has been brought out in the discussion. The point that the speaker was considering was the relative merits of the two types of filters in general. In all engineering problems there arise peculiar conditions which necessitate designs that would not be considered advisable in general practice. The case cited is one in which the peculiar local conditions prevent the use of the more desirable gravity filters and require the substitution of the pressure type.

Mr. Milligan has cited many desirable features in pressure filters, but the speaker wishes to emphasize the fact that for most water supplies, where basin treatment is important, the pressure is inferior to the gravity.

If pressure filters are reserved for the few special places where they are peculiarly suited there is no objection. The indiscriminate installation of them without regard to the nature of the problem, and the encouragement of their use in general in place of gravity filters, is a step in the wrong direction. It might be a very desirable proposition from the manufacturers' standpoint, but from the standpoint of efficiency of results a very poor one.

There are many who would take issue with Mr. Diven in the statement that the small filter giving poor results is better than no filter. The user of water from these has a feeling of false security; the speaker has in mind several pressure filter installations that are furnishing a poorer effluent water than influent water.

Mr. George A. Johnson: Mr. Stevens' paper is suggestive and timely. It would seem that the pressure filter has hardly been given a fair show by water filtration men in general. When this type of filter first came under the speaker's observation during the Louisville experiments twenty years ago, while confessing that he knew less about filters in general then than now, he looked upon it as a sort of catch-as-catch-can arrangement, and unreliable. Well, in a general way it proved to be so in that case, but the method of rate control in that filter was elementary and encouraged trouble, and the filter had to work under about as bad conditions as normally are encountered.

The present day pressure filter of the advanced type is a great improvement over the pressure filter of twenty years ago, and it is being improved yearly. The speaker has great confidence that it will develop into a far broader field of usefulness in the near future than it has in the past. Its use is much more widespread than people generally have been led to believe. One hundred and fifty-one plants for municipal supply with a total capacity of 265 million gallons daily, is not an insignificant showing. Quite the contrary. The present capacity of all rapid sand filter plants for municipalities is something like 2000 million gallons daily, hence the pressure filter is represented to the extent of 13 per cent of the total, and this does not include the hundreds of pressure filters used for industrial service, hotels, residences and the like.

It is a quite notable fact that the pressure filter is looked upon with considerable favor by private interests. Of all the pressure filter plants for municipal supply over one-third are owned by private companies. Now all water works should be run as a business and on a business basis. The water department of a city is often a source of substantial revenue. Private water companies are certainly run on as efficient a business basis as possible, and as in all business, the first thought is to furnish satisfactory service at the lowest feasible production cost. To the speaker's mind the explanation is clear why so many privately owned filter plants are of the pressure

type. Their operators evidently are able to get good service for less money than they would be able to get with a gravity filter. This seems like a good argument for pressure filters.

There is another phase of the general subject of water filtration which favors the pressure filter. Sterilization is referred to, which in the last few years has come into almost general use. Consequently the water filter, *per se*, may now be looked upon essentially as a mechanical strainer; a device for removing suspended matter, and coloring matter which has been coagulated; and not as the highly efficient medium for removing bacteria sought for years ago.

Water filtration practice was revolutionized with the development of the art of sterilization with chlorine compounds. For years there was an insistent endeavor to develop sterilization by such agencies as ozone, copper compounds and the like. But they all failed, or were shown to be undesirable, until the hypochlorite treatment was placed on a sound footing in 1908-1910. Here was found a highly effective, easily applied and cheap method of sterilization. Its use spread like a prairie fire.

With the realization that a cheap and efficient, as well as easy method of sterilizing water had been found, one which had no bad after effects, the necessity for relying upon the water filter in itself to remove the dangerous bacteria from water passed away. The water filter was still needed to remove color and turbidity, but the really consequential phase of the bacterial side of the purification process could well be taken care of by sterilization.

Unquestionably the profoundest enemies of the pressure filter are those who consider it unreliable from a standpoint of bacterial removal. But now we must be fair and admit that the time is past when any filter need be required, or expected, to remove all disease bacteria, consequently the greatest objection to pressure filters is thus nullified. The idea persists, nevertheless, for even the author says in his conclusions:

> The pressure filter, as thus far constructed, is in some instances a very inferior means of purifying water hygienically, and in other cases an excellent means, but on the average it is not entirely reliable.

Here we have it again. It is in some instances an inferior means of purifying water *hygienically*. It seems to the speaker that so much emphasis should not be placed upon the hygienic deficiencies of the pressure filter, for filters of all types in municipal water puri-

fication systems are not selective in their action, and all of them pass disease germs at one time or another, and none of them ring a bell when they do so.

Further than this the speaker sees nothing important to criticise in the conclusions of the author. The pressure filter seems to be somewhat better adapted to the treatment of some waters than gravity filters; it is especially qualified to treat supplies small in volume; and the cost of construction is usually low in comparison with gravity filter installations. There is need that consideration be given to the pretreatment of waters applied to pressure filters, and certain construction details require attention, particularly as regards the elimination of "dead areas" in the sand bed, control of the rate of filtration, and maybe better washing facilities. With these features developed, so far as practicable, the speaker is firmly of the opinion that the pressure filter is entitled to a prominent "place in the sun", and that the future will see its use to a far greater extent than in the past, for the treatment of practically any water, and in practically any amount.

Mr. Harold C. Stevens (closing discussion): At the commencement of this closure the author feels that he must take exception to the editorial comments which appeared in the *Engineering News* on June 15, 1916. The statements are there made that his paper was a "remarshalling of the old arguments in favor of pressure filters," and that "the majority of speakers favored its use only under exceptional conditions." These are not altogether correct statements.

The first part of the summary's conclusion says "The pressure filter as thus far constructed is in some instances a very inferior means of purifying water, and in other cases an excellent means, but on the average it is not entirely reliable." The author's argument for pressure filters is conditioned on improved design, embodying controlling devices, similar to those provided for well-designed gravity filters, and including in many instances settling basins of adequate size. This argument is supported, in some cases very directly, by Messrs. Mason, Ledoux, Fuller, Gwinn, Milligan, Diven and Johnson. Messrs. Chester, Leopold and Catlett take an opposing view, apparently without considering the subject from the point of view of the author, but rather as dictated presumably by the results of their experience with pressure filters as usually equipped heretofore.

Most of the speakers expressed the opinion that the pressure filter with proper improvements and accessories will find a much broader field of usefulness than the pressure filter of the past, and other speakers felt that this field would be very restricted.

The cost of satisfactory filtered water is the crux of the whole question, and the author believes that pressure filters will prove the more economical in a surprising number of future installations.

Dr. Mason likes to see "the wheels go 'round." So does the author, and for many years he felt it was an advantage favoring the gravity filter to be able to see the wash water turn over on its way to waste; but now that engineers have learned how to lead off the waste water and how a sand bed "feels" when it is washing well or poorly, visibility and accessibility are not of much importance, except in the case of helping out a bad design by renewals of strainers or filtering material.

Mr. Brown and Mr. Chester have directed attention to the breaking up of the particles of coagulum when the applied water is pumped from a settling basin, and some additional remarks about coagulation seem to be appropriate here.

There may be said to be three ways of applying coagulant in connection with pressure filters:

First. Apply the coagulant in the supply pipe, relying upon the reaction taking place in the water above the sand. In this case a portion of the coagulant may pass undecomposed through the filter and cause the after appearance of hydrate in the effluent. This is, of course, more likely to happen with the waters which react slowly. The method is the most familiar one, but it will not go with muddy water, even if the floc formation is satisfactory, on account of too rapid clogging of the filter sand. In some instances it is permissible and even desirable, but it should be adopted only after most careful consideration.

Second. This is like the first, except that the applied water is passed through a closed reaction chamber, usually called a settling chamber, before going on to the filters. This chamber is too small to be of much account as a settling chamber. The only advantage of the method is that the reaction period is lengthened.

Third. Effect coagulation in a full-size open settling basin and pump the settled water to the filters. The problem of pretreatment is then the same as with gravity filters and the water applied to the filters is the same, except that the coagulum is broken up in passing

through the pumps. The author's opinion that the breaking up of the flocs does not impair the efficiency of a pressure filter to a considerable extent is sustained by Mr. Ledoux in speaking from very extensive experience.

Mr. Ledoux considers that the main advantage of pressure filters lies in the elimination of low-lift pumping, believing that otherwise the difference in cost will be in favor of gravity filters on the basis of equivalent equipment. This dampens the author's optimism somewhat, but he still believes that, even with an adequate open settling basin and double pumping, a pressure filter plant in a great many instances will be less costly to construct and operate than a gravity plant, and therefore looks upon the total cost as the basis of comparison. Mr. Chester holds that the costs of similarly well-built plants will be equal. Mr. Fuller considers cost the main consideration and rightly says that it will have to be figured out under each set of circumstances. Mr. Milligan and Mr. Johnson think that pressure filters have the advantage, therein confirming the author's view.

Mr. Ledoux is quite right in his criticism of strainer systems in general. A few may be termed almost satisfactory, but perfection has not yet been reached. The strainer system is the heart of a filter, and the designer must still bend his energies to its improvement, wherein lies the only hope of effectually eliminating displacement of filtering materials, and progressive accumulation of sediment within the filter bed.

The difficulty which the curved sides and ends of a horizontal filter shell present against obtaining uniform distribution of wash water can be eliminated by filling out the segments to a vertical plane, with no great difficulty and at no great expense.

Mr. Chester's comments regarding the attitude of state boards of health convey the idea that such boards are dead set against pressure filters. Perhaps this is true with regard to plants like most of those that have been installed heretofore, but the author does not believe that any such board would withhold approval of a well-equipped pressure filter design. He knows of one state board that is not opposed to pressure filters as such, and doubts very much if the requirement of a sight gravity feed is intended primarily, as Mr. Chester thinks, as a subterfuge to preclude the installation of pressure filters.

Mr. Chester explains that the collecting trough for waste wash

water is an important part of the pressure filter. It is essential to effect the removal of dirty water quickly, by the shortest path possible, in order to get rid of the sediment without needlessly and wastefully prolonging the period of washing.

Mr. Chester takes exception to the statement that "The cost of operation of pressure filters should be about the same as in the case of gravity filters, except that the cost of pumping may be a little greater, on account of the greater head utilized in the filter." The author had in mind pressure filters with open settling basins. The cost of single pumping is unquestionably somewhat less than double pumping, but the difference is only a very small percentage of the total cost of operation.

Mr. Leopold's views regarding pressure filters are pessimistic to say the least. The idea of discouraging the use of pressure filters for the treatment of municipal supplies simply because some inexperienced engineers may install poorly designed plants or because some filter manufacturers may foist an inferior plant on an unsuspecting community, is certainly not in the line of progressiveness. Mr. Leopold, with most evident sincerity, has rung in a false alarm. There are plenty of engineers who can design pressure filters creditably, and the prominent filter companies will undoubtedly lend their best efforts most effectively to raising the standard of pressure filters. State boards of health and the like, as is emphasized by Mr. Chester's views, can be depended on to block with disapproval the installation of plants that will fail, and so put an effective check on the inexperienced engineer and the unscrupulous manufacturer.

Mr. Gwinn's discussion is a welcome addition in substantiating the right of the pressure filter to a "place in the sun," quoting Mr. Johnson's expression, and he backs up his opinion with a comprehensive tabulation of results.

Mr. Milligan's support is very gratifying to the author as an impartial and thorough consideration of the pressure filter question by one who is exceptionally well qualified to regard it from the viewpoints of both the engineer and the manufacturer.

Perhaps the most important part of his discussion is that which deals with rate of filtration, showing that in many cases the rate may properly be increased to double the usual maximum rate for gravity filters. Sterilization is an effective safeguard against the comparatively small decrease in efficiency that results from the high rates.

The author does not unqualifiedly endorse such higher rates. They should be adopted only after a careful investigation of the character and variation of the raw water and of the conditions under which the filter is to be used. When a high rate is found to be permissible the advantages of the pressure filter over the gravity type will be unquestionable with regard to cost.

Mr. Catlett voices briefly the unkindly feeling of the public health officers towards pressure filters, but his last sentence, "The ideas of health officers are largely based on results," indicates that they are nevertheless open to conviction. There are a few pressure filter plants, built or building, that are what the author regards as up-to-date. It is to be hoped that the operating results of such plants, both as regards cost and efficiency, will be promptly published in engineering periodicals.

Exception is taken to one of Mr. Catlett's statements, namely, that "Proper basin treatment is not possible in connection with pressure filters." It certainly is just as feasible to provide an open settling basin in connection with a pressure filter, as it is with a gravity filter, at an increased cost, of course, which may or may not, leave a balance in favor of the pressure filter.

As regards efficient supervision, the requirements of pressure or gravity plants are identical.

Mr. Diven, and also Dr. Mason, tell of the situation at Troy where the conditions strongly favor the pressure filter. Evidently there will be no coagulating basin and, if Mr. Chester is correct, a sight feed for applying coagulant under pressure will have to be provided before the approval of the state authorities can be obtained. The author wonders if this will seriously hamper the project.

Mr. Johnson points out that, in view of the effectiveness of final treatment with chlorine compounds, high bacterial efficiency in filtration is not essential, and criticises the use of the word "hygienically" in the sentence "The pressure filter as thus far constructed is in some instances a very inferior means of purifying water hygienically, and in other cases an excellent means, but on the average it is not entirely reliable." The writer agrees that the word should have been omitted, and in fact intended to have it stricken out, but it inadvertently was retained. Nowadays the real purpose of a filter of any kind is to clean the water thoroughly and dependably and this demands that it shall be so designed and controlled that derangements and deterioration of the apparatus shall be eliminated

to the fullest practicable extent. Mr. Johnson's closing remark that "the future will see its use to a far greater extent than in the past, for the treatment of practically any water, and in practically any amount" shows very full confidence in the capabilities of the more improved pressure filter.

Mr. Ledoux expresses regret that the author did not present data concerning the results obtained with various plants. The author is indebted to many water works men, and especially Mr. Ledoux, for information furnished upon request, and found this information very helpful. It was not tabulated in the paper for the reason that time was too short for the correspondence which would have been necessary to clear up certain doubts and prepare it for publication. Mr. Gwinn's discussion, which includes a comprehensive statement of the results obtained at Terre Haute, compensates for the omission, but the author is glad to add a tabulation of the data as received.

Operating Results of Various Pressure

		ATLANTA, GA.	DAVENPORT, IA.	EAST JERSEY COAST WATER COMPANY	EUREKA, COL.	HOLMESBURG, PA.	KINGSTON, N. Y.		MEDIA, P
Capacity of plant (m.g.d.)		21.00	8.0	1.75	1.25	5.00	3.0	3.0	1.0
Average consumption (m.g.d.)		17.00	4.0	....	.64	2.00	2.70	2.30	0.6
Source of water supply		Chattahoochee R. Storage Res'r	Miss. R.	....	Elk R.	Pennypack Cr. Sandy Run	Storage Res'r.	Storage Res'r.	Ridley
Capacity of coagulating basin (gallons)		6,000,000	5,000,000	....	32,000 to 90,000	1,000,000	None	None	50,0
Air agitation		No	Yes	....	No	No	No	No	No
Sterilization		No	Yes	....	Yes	Yes	Yes	Yes	Ye
Period covered by averages (yrs.)		....	....	....	....	1	1	1	....
Turbidity of applied water (p.p.m.)	Average	27	50	....	80	20	2	4	1
	Maximum	135	....	....	500	6000	....	....	150
Bacteria per c.c. in applied water	Average	50§	....	237	40§	9400	2868‡	2517‡	70
	Maximum	500§	....	500	65§	200,000	....	....	500
Bacteria per c.c. in effluent	Average	6§	10 to 50‡	19	13§	31	19‡	17‡	....
	Maximum	500§	....	50	70§	300	....	....	....

* The Media plant has just been improved by the addition of a 2,000,000 gallon sedimentation and coagulating basin, a wash water tank, and loss of head

‡ Incubated on gelatin at 20°.

§ Incubated on agar at 37½°.

ϕ Incubated on agar at 20°.

Operating Results of Various Pressure Filter Installations

HOLMESBURG, PA.	KINGSTON, N. Y.		MEDIA, PA.*	MILLEGEVILLE, GA.	NESHAMINY, PA.	CONSOLIDATED WATER CO. OF SUBURBAN, N. Y.	ONEONTO, N. Y.
5.00	3.0	3.0	1.00	0.75	2.50	....	3.00
2.00	2.70	2.30	0.60	0.25	1.00	....	1.50
Pennypack Cr. Sandy Run	Storage Res'r.	Storage Res'r.	Ridley Cr.	Creek	Neshaming Cr.	....	Storage Res'r.
1,000,000	None	None	50,000	100,000	160,000	....	None
No	No	No	No	No	No	....	No
Yes	Yes	Yes	Yes	....	Yes	....	Yes
1	1	1	....	....	....	....	....
20 6000	2	4	15 1500	50 3000	12 2000	25 3000	20 ....
9400 200,000	2868‡	2517‡	700 5000	300 3000	150 75,000	500 3000	300 ....
31 300	19‡	17‡	....	15 32	4 50	20 100	15 ....

coagulating basin, a wash water tank, and loss of head and rate of flow gages.

ONEONTO, N. Y.	PLANT NEAR PHILADELPHIA	RAHWAY, N. J.	ROCHESTER, N. Y.	STREATOR, ILL.	TERRE HAUTE, IND.
3.00	5.00	6.00	6.00	3.50	8.00
1.50	4.00	4.50	4.40	1.90	4.81
orage Res'r.	Crum Cr.	Robinson Br. Imp. Res'r	Lake Ontario	River	Wabash R.
None	300,000	None	....	390,000	....
No	No	No	No	Yes	....
Yes	Yes	Yes	Yes	....	Yes
....	....	....	6	....	5
20	15	10	12	200	111.6
....	1500	90	121	4000	3000
300	700ϕ	350	4112	13,000	1067
....	5000ϕ	3500	39,830	320,000	15,000
15	8ϕ	3	68	14	488
....	50ϕ	275	2587	110	....

DISCUSSION

RESERVOIRS[1]

By Dabney H. Maury

President Hill: We are very much indebted to Mr. Maury for this paper, because he has focussed attention on a very important principle of design which is frequently overlooked, that is, the great economies which may be effected by the proper location of a storage reservoir in conjunction with the distribution system. We are also indebted to him for the frank and fair way in which he has discussed all the difficulties which he has encountered in the construction of these reservoirs.

Mr. John C. Trautwine, Jr.: A philosopher has called attention to the beneficence of Providence in making its great rivers flow generally past our great cities. The same Providence seems to have surrounded Philadelphia with a rolling hill-country, with numerous tempting reservoir sites, with special reference to the city's needs in the matter of water supply.

From the beginning, in 1800, Philadelphia's public water supply was pumped from rivers to reservoirs, until, some fifteen years ago, the great Torresdale plant was installed, filtering the Delaware water there, and forcing it from Lardner's Point into the distribution by practically direct pumpage.

Mr. Maury has discussed the construction of reinforced concrete reservoirs. Philadelphia's first reservoirs were of reinforced wood. They were nearly cylindrical wooden vats, in the upper story of the tiny Centre Square repumping station, which occupied part of the present site of the City Hall. Their designers did not commit Mr. Maury's self-confessed mistake of putting the circumferential reinforcement on the inside. The bands were in the usual place.

But these first works, a sad abortion from the beginning, remained in operation hardly fifteen years, and they were then succeeded by the first, or steam, works at Fairmount, with their then world-

[1] Published in June, 1916, Journal, Vol. 3, No. 2, at pp. 618–652.

renowned Fairmount reservoir, built immediately back of the pumping station upon a rocky hill which seems to have formed the site of one of Montresor's line of British fortifications This line stretched from river to river just north of what was then the northern limit of the city.

Beginning with Fairmount, the city has built a remarkable series of earthen reservoirs, on nearby eminences, gradually increasing in capacity, and culminating in the three large reservoirs: East Park, 1887-1889—689,000,000 gallons; Queen Lane, 1894—383,000,000 gallons; Roxborough (new), 1893—147,000,000 gallons.

It will be seen at once that the dimensions of these reservoirs take them well out of the class discussed chiefly by Mr. Maury. Their history has been interesting, and, in a sense, pathetic.

East Park, a gigantic undertaking for its day, was long a-building, with protracted intervals of "nothing doing," and something of scandal. It seems now to be practically out of service, being filled with unused raw water.

Serious leakages from Queen Lane, when water was first turned in, afforded fine opportunity for the opposition press to belabor the administration; and Roxborough would doubtless have fared as ill, if its smaller size and its greater distance from the center of the city had not rendered it relatively inconspicuous.

Interior asphalt linings were promptly applied to both Queen Lane and New Roxborough reservoirs, and they have since been in full service without evidence of leakage; but at Queen Lane the south basin now acts as a settling basin, preliminary to filtration, while the north basin forms a filtered waterbasin for slow sand filters placed immediately over it; and at New Roxborough both basins serve as sedimentation basins for the nearby filters.

Thus, Philadelphia, once wholly committed to the use of large earthen reservoirs, for storage, now depends rather upon ample and modern pumpage capacity, drawing upon those unfailing sources of the raw material, the Delaware and Schuylkill rivers.

Mr. Alexander Potter: The author has very lucidly set forth the importance of the proper relative location of the service reservoir to the pumping station, and how large drafts upon the reservoir cause substantial drops in pressure in the case of an improperly located reservoir, while little or no drop occurs in case of a properly located reservoir.

This matter very logically has a very important bearing on the question of equitable insurance rates, but the speaker has yet to learn where the insurance companies have either given lower rates to the cities adopting the safe plan or penalized the city adopting the hazardous plan. The speaker's experience with the insurance companies would indicate that they would rather have a double pumping line to the city, which is more expensive and less serviceable, than a double supply, which is available in every city, where the service reservoir is on the opposite side of the center of consumption to the pumping station. The importance of this matter merits serious consideration.

Turning attention to the technical aspect of the paper, it can be safely stated that the economy and serviceability of reinforced concrete for reservoir construction are universally recognized, and engineering literature is replete with theories of design and construction. Nevertheless, very few of the reservoirs that have been built cannot now be improved upon. There is still room for progress in the art of designing such structures, and this can best be made by a careful study of all existing structures with special reference to the difficulties encountered in their construction and to the defects which have developed in such structures under service. The author, in giving his personal experience with the design and construction of some of the largest reinforced concrete reservoirs in this country, is adding a very valuable contribution to the design of reinforced concrete.

Most of the reservoirs described by the author are either built entirely below the surface of the ground or are surrounded by substantial earth embankments. Under these conditions the earth backing or embankments should be relied upon to resist a very large portion of the hydrostatic pressure. The concrete itself serves, to a very large extent, as a watertight lining. In such structures, as a rule, complete failure does not develop; partial failure, however, is quite common and is usually evidenced by considerable leakage. Such leakage is ordinarily readily remedied if it is due to defective workmanship, but cracks due to structural weakness, on the other hand, are frequently very difficult to make water tight.

The speaker agrees with the author that it is practical, with proper mixture and good workmanship, to obtain a concrete sufficiently water tight for reservoir purposes. In so far as materials

are concerned, the most important factors are sufficient cement and well graded sand. With the ordinary mixture of one part of cement, two parts of sand and four parts of broken stone, a concrete water tight for all practical purposes can be obtained if the sand contains the necessary amount of fine particles. With coarse sand it is advisable to add additional fine material to make a dense concrete. Hydrated lime ranging from 5 to 10 per cent of the weight of the cement used will give excellent results.

In thin sections concrete should be placed in layers not exceeding 8 or 10 feet in depth so that it can be readily worked around the reinforcing bars and spaded in the vicinity of the forms.

Another important factor, and one very often neglected, is the shape of the steel used for reinforcing. Round bars, or bars approximately of circular shape, are to be preferred. Square bars more than one inch thick should not be used at all in a wall section, for with such large size bars it is very difficult to get the concrete to flow into and fill the space just below the bar.

The author appears to have used structural channels extensively in connection with reservoir work. The speaker questions this practice, for the following reasons:

First. Structural channels used in thin wall sections tend to weaken the tensile strength of the concrete by breaking up its continuity.

Second. With such large sections it is very difficult to completely fill with concrete the space underneath the horizontal rods adjacent to the channels.

Third. The same amount of vertical steel more evenly distributed in small sections around the perimeter of the reservoir would give more satisfactory results, for vertical reinforcement is not only needed to hold the horizontal bars in alignment during construction, but a certain amount of vertical steel properly distributed is necessary to resist the vertical secondary stresses developed in this type of reservoir wall.

The disadvantages just enumerated more than balance, in the speaker's opinion, the advantage of simplicity of erection and the positive spacing secured by the use of structural steel channels.

In building concrete reservoirs in which the hydrostatic pressure is resisted by ring tension, the grave mistake is sometimes made of placing the steel too near to the inner surface, which results in the development of secondary stresses of considerable magnitude.

Theoretically, in a thick, hollow cylinder, the tension is a maximum at the inside surface, but this is not the proper location for the reinforcing bars in a reinforced concrete circular reservoir. If only one set of circumferential bars is used these should be placed nearer to the outside surface than the inside. The most economical arrangement in wall sections 12 inches or more in thickness is in using two concentric rings of reinforcing bars, one placed within 2 inches of the outside surface and the other within about 3 or 4 inches of the inside surface. Such a distribution is very effective in resisting not only the hydrostatic pressure but in resisting whatever secondary stresses may be developed in the shell from any one of a number of causes. With the reinforcing steel placed too close to the inner surface the concrete at the outer surface is frequently overstressed, resulting in partial failure and a leaky reservoir which it will be most difficult to make water tight.

The speaker sees no reason why the use of chutes for conveying concrete should not be permitted provided concrete is not allowed to flow along the forms but is pushed laterally by means of a hoe or some other suitable instrument, at the same time working the material to a proper consistency.

The defects developed in the concrete lining of the new 4,000, 000 gallon reservoir illustrated in figures 13 and 14, are not in the speaker's opinion due primarily to the use of the water proofing compound. He is rather inclined to believe that in placing the concrete the contractor permitted a rather wet mixture of concrete to flow laterally along the forms. This resulted in a partial separation of the cement, sand and stone. The cement which accumulated in pools of water resulted in the formation of laitance. This laitance when set possesses a creamy or yellow color and can be freely carved with a knife, its consistency being that of clay, only very porous. The speaker recalls an instance where, in building a series of reinforced concrete arches, the cement mortar collected in pools at the springing line of one of the arches, resulting in the material possessing the same properties as those mentioned by the author. No waterproofing compound was used in this instance.

The waterproofing compound in the instance of the 4,000,000 gallon reservoir, though not a direct cause, in all probability aggravated the formation of the objectionable substances referred to by the author.

Contrary to usual opinion, leakage at construction joints, pro-

vided proper precautions are taken, is never serious, and such leakage can be practically entirely avoided by the use of sufficient steel tying the sections together or by the construction of a water tight expansion joint. In bonding new concrete to that which is set the connection surface should be fairly rough and clean. The practice, after the concrete has set, of roughing the surface with picks or chisels should be condemned, for the effect of the blows of the chisel or pick penetrates the mass to a considerable distance, especially when the concrete is comparatively clean, leaving the aggregate below the construction plane loose, through which leakage may later take place. A good watertight bond can be secured by spreading upon the connecting surface immediately before concreting a $\frac{1}{2}$ inch layer of semiliquid cement mortar. This mortar should be thoroughly brushed into all crevices and worked back and forth over the surface so as to assure a good bond to the concrete mass, otherwise a film of dust or dirt might prevent proper adhesion. The use of a vacuum cleaner, as suggested by the author, should be of value in removing dust and rubbish from narrow sections difficult to get at.

The pouring of grout between the forms and the concrete backing, as followed in the construction of the 10,000,000 gallon reservoir at Bloomington, Illinois, is a refinement not necessary to secure satisfactory results, and to the speaker's knowledge is no longer generally used. This method, although it gives good results, is very costly and is not without its drawbacks, for when the sheet metal forms are left in too long the mortar lining does not properly bond to the body of the concrete, and when set, sounds hollow under the blow of a hammer. This is especially the case when a richer mixture is used in the mortar lining than in the body of the concrete.

Mr. W. F. Wilcox: Are not the channels criticised by Mr. Potter intended to keep the reinforcing in place and not to increase the strength? Of course we all know that the distribution of the steel in the horizontal layers would add more to the strength; but in looking over Mr. Maury's design the speaker did not understand that he undertook to increase the strength of the reservoir.

Mr. Dabney H. Maury: Perhaps Mr. Wilcox did not understand quite clearly the reference in the paper to channels. The

channels were used not without consideration of the points raised by Mr. Potter; but they were used as a choice between several things which might have been done. They seemed to offer structurally the most convenient method of placing and holding in place the steel which has to be bolted or tied to something in the practical work of constructing the reservoir. They were not inserted for their reinforcing value, for while they might help a little in preventing horizontal cracks, their usefulness in this respect would be negligible, as the upper end of the wall is free to move, and vertical temperature steel would therefore be unnecessary.

The supposed danger of cracking that might result from the insertion of these channels, which would occupy only a very small percentage of the cross-sectional area of the wall, was not actually present, because in the design of the walls the tensile strength of the concrete was in no case relied upon, the stresses in the steel being kept low enough to prevent vertical cracks. No vertical cracks could be found with a magnifying glass in any of the reservoir walls at any time, either near the channels or anywhere else, except the entirely harmless cracks on the outside of the bottom of the 4,000,000 gallon reservoir, which cracks were fully described in the paper and which, as therein stated, were due to the author's overlooking the precaution referred to by Mr. Potter, and failing to put a part of the reinforcing steel near the outer edge of the wall.

It would have been manifestly unsafe to rely on the earth pressures because in very dry or very cold weather it might readily happen that the earth would shrink away from the outside of the wall of the reservoir to such an extent that the internal pressures might, if the wall were not strong enough to resist them unaided, set up disastrous cracks in the wall before the wall had stretched enough to come into bearing against the outside earth. The foregoing remarks apply with full force to all of those reservoirs in which the pressures were resisted by steel placed hoop-fashion in the wall.

In the design of the 7,500,000 gallon reservoir, that portion of the wall which rested against solid rock had no horizontal reinforcement, but was simply a lining placed against the rock, the rock being relied upon to take all of the stresses. In that portion of the wall which extended above the rock, and most of which was surrounded by earth, no reliance was placed on the outside earth for the reason already given, namely, that the wall at some time might have yielded to the breaking point before it could come into bearing against the earth.

In the design of the 1,200,000 gallon covered reservoir no reliance was placed on the earth pressures for similar reasons. The design of this reservoir involved much study of the best method of holding the bottom of the wall, not only against internal water pressures, but against the thrust of the inverted groined arches. This could have been accomplished by putting reinforcing steel all over the bottom to take care of the thrust; but had this been done there would have been no economy in using the inverted groined arch, a type of bottom which was peculiarly well suited to the local conditions, not only because of the loads which will later have to be carried by the columns, but also because of the possibility of trouble on account of high ground water during construction.

The next alternative which presented itself for taking care of the combined thrusts of the water and of the arches was the construction of a massive gravity-section retaining wall around the reservoir, the weight of which would be so great that friction alone would prevent its starting to move. Such a wall would, however, have added greatly to the cost, and the advantage that might have been gained by utilizing the tensile strength of the bars in the roof slabs to hold the top of the wall in place would practically have been wasted.

It was finally decided to make the outermost bay, on each of the four sides of the reservoir, of reinforced concrete so designed that its weight, plus the weight of its contained water, would provide sufficient friction to prevent its starting to move outward, even when impelled by the water pressures as well as by the thrust of the arches. This same outer bay would also have, when the reservoir is empty, sufficient weight to produce friction that would enable it to resist, without moving, the thrust of the groined arches. The space inside of the bay is of course useful for the storage of water.

These explanations will, it is thought, make it clear why it would have been unwise in any of the designs referred to, to place any reliance on the pressures of the outside earth.

Mr. W. F. Wilcox: You have answered the question the way the speaker wanted you to answer it. You have explained that according to his own idea or conception of designing a reservoir, he having designed and built several reservoirs. With the first

one built there was a very unfortunate experience, some reliance was put on a bank of earth, it was built on the seashore where there was running sand. Some time after it was built the municipal authorities removed the embankment from the outside of the reservoir and dug underneath the reservoir to see if there was any leak in the bottom. They were very much surprised that the reservoir cracked, and called the speaker in a hurry and asked him why it cracked? The polite answer was that it was not "fool proof."

Some years ago the speaker built a 20,000,000 gallon reservoir with a heavy embankment and heavy excavations. The embankment was built in six inch layers, carefully watered and carefully rolled. It was found that it was impossible to roll the outside edge of the embankment; therefore, after the reservoir field had been ploughed according to the plans, the inside surface was dressed down until it was firm and compact The lines of the design were changed so as to put in a concrete lining on a firm bank. The edges of the applied squares were painted with ordinary paving pitch, and then alternate squares were put in. In putting these squares together a circle 6 inches in width and 3 inches deep was left. This was then carefully painted with paving pitch, and the filler concrete put in. No leaks have been found in it. It was a very cheap method of construction and has given very satisfactory results. The entire work was completed in fifty-seven days.

In a vertical thin wall reservoir the speaker uses two lines of steel, putting sufficient steel in to take care of all the stresses, not depending upon the concrete for any stress. He built a reservoir 100 feet square, 20 feet deep, using ordinary steel plates 12 inches wide, and hot paving pitch to make the expansion joints. The width of the buttresses on the outside was doubled, one-half of the buttress being put up when the first section was put up, and when the plate was inserted sticking out 6 inches. That reservoir has been up ten years and has never leaked. In the construction of a dam where there was 80 feet of water, paving pitch was used, making a number of applications of the pitch, drying between coats, until it became a quarter of an inch thick. Three foot observation holes were left, and men sent down into those holes for the past five years have found that they held.

In regard to changing mixtures and adding hydrated lime, a mixture of one, two, four with properly selected material properly placed will make a reservoir practically tight. There will be in

the construction some weak places which will develop but those can be readily cut out and doctored. The leakage will be very small.

The speaker does not think it well to use any plaster on the inside of the wall. It might be advisable under certain conditions to use some waterproofing material. That is entirely within the judgment of the engineer. If you will use in an ordinary settling basin a small percentage of alum, the sedimentation in water will finally take up the leaks and bring about satisfactory results.

Mr. Dabney H. Maury: Mr. Potter's recommendation that in roughening the surface of the completed work before pouring new concrete on top of it, there should be no jarring or chipping, is a wise one. The author's specifications in regard to that provide that the roughening of the surface should be limited to scratching it.

Mr. Potter's suggestion in regard to the use of round rods was also a very good one. Round rods have another advantage on which Mr. Potter did not touch, and that is that they bend much better than square or deformed rods. If you undertake to bend a square rod it is very hard to make it stay in the same plane. In bending a round rod there is no tendency for the rod to get out of the same plane, and this is a decided advantage.

With regard to the mortar forms Mr. Potter has suggested quite properly a number of precautions that should be taken. Those precautions had not been overlooked, and are all included in the specifications for the last reservoir for which the author prepared plans, and in which the use of these forms was required. It is true that if not used properly there may not be a good junction between the mortar facing and the concrete back of it. Used properly, these forms serve an excellent purpose by insuring that no stone shall rest against the inner face of the forms. In any event their use conduces to a care on the part of the contractor and of the inspectors that probably would not be secured by simply specifying, as is usually done, that the contractor shall spade the concrete thoroughly next to the forms. There is something definite there that the inspector will be watching all the time, and in a general way they thus conduce to the care with which the construction is carried out. Careful estimates of the additional cost of these forms were made, and this cost was found to be lower than the value of the advan-

tages that would result from their use. There might of course be cases in which the estimates would give contrary results; but when the advantages are considered and weighed against the cost, the author believes that in many instances it will be found good practice to use the mortar forms.

Mr. Alexander Potter: With reference to the exceedingly low amount paid to the contractor for the Bloomington reservoir, $35,000, it seems out of proportion to the actual cost. Can the author tell us what were the conditions that caused the contractor to accept so low a price? What proportion of the saving on the other work undertaken by him can be properly charged to the reservoir? The price is so very low for a reservoir of this capacity that it seems hardly a fair figure to give as representing the cost.

Mr. Dabney H. Maury: That is quite a proper question. The contractor's original bid was $37,500. If the work had been awarded to him on his original bid he would probably have made about $2,500 profit. The actual cost to him was, as nearly as it could be figured, $35,000. That allowed him nothing for his own time, and nothing for his partner's. They stayed on the work, dividing the time between them, day and night. They got nothing for their own services and nothing for depreciation on their tools, or plant. Prices at the time were fairly low. They were not as low as they have been in the last two or three years preceding the recent sudden rise due to the war, but they were lower than the average prices. The author believes that the excellent results were accomplished largely by the earnest and conscientious work of the contractor. The author had nothing to do with the supervision of the work, but was simply employed to make the plans and specifications, and can claim no credit for anything else.

Mr. Alexander Potter: The speaker would appreciate it if the author could include the unit prices of the work, because, compared with works with which he is more familiar, the cost of the Bloomington reservoir seems so very low. The unit prices would be interesting for comparison.

Mr. Dabney H. Maury: The author would be glad to do that if he could. The reservoir is, however, an old one, built about

eleven years ago at Bloomington, Illinois. The contracting firm that built it has gone out of business, and the unit prices would probably be hard to obtain. The author took at the time the contractor's own figures of his costs, but not in any very great detail. The author knew the amount of the bid, and the amount which the contractor said he made, which was nothing. The author thoroughly believed him. Of course, in considering the costs of that reservoir one should bear in mind the fact that it is a large reservoir; and while $3,500 per 1,000,000 gallons capacity is probably the record for a reinforced concrete reservoir involving so much excavation, the same type of reservoir, if of only 5,000,000 gallons capacity, would have probably cost $5,000 or $6,000 per 1,000, 000 gallons. There were no unusual difficulties encountered. The excavation was clay for the top soil, with bottom soil of sand and gravel, all which could be handled very easily. The contractor used good construction methods; he and his partner stayed there day and night, and they completed that work in one hundred days.

The details of the construction of that reservoir were quite fully described in *Engineering Record*, of March 3, 1906, in an article written by Mr. S. T. Henry, of the editorial staff of the *Record* at that time, who obtained many of the construction details from the contractor.

DISCUSSION

THE TYPHOID TOLL[1]

By George A. Johnson

Mr. George A. Johnson: It is about time we all realized that as they now are constituted, and as they now operate, health departments are not all that they are cracked up to be in many things, and that they should be given more moral and financial support in order that they may become more efficient. Also, the personnel of many such departments is capable of liberal improvement.

Sewage treatment is of course an aid in minimizing typhoid; but it is pretty generally recognized by sanitarians as a class that sewage treatment can do no more practically than to minimize the potential dangers of water pollution. It usually is aimed chiefly at the proposition of rendering sewage less offensive. So far as effecting the complete destruction of bacterial life is concerned sewage treatment is a dismal failure. It cannot be done reliably three hundred and sixty-five days in the year by any practical method, consequently we have to recognize that a certain amount of dangerous water pollution is inevitable.

All surface water should be filtered. We learn from statistics that following filtration of the public supply there has been a consistent reduction in the typhoid fever death rate ranging between 65 and 95 per cent, the average being around 75 per cent. This measures the reduction in the total typhoid death rate in the community; it is not a true measurement of the amount of water borne typhoid eliminated by water filtration; if such a measurement were possible it would probably be shown to be nearly, if not quite, 100 per cent.

Up to this time the speaker has not mentioned the Hazen theorem, namely, that where one death from typhoid fever has been avoided by the use of better water, a certain number of deaths, probably two or three, from other causes, have been avoided.

[1] Published in June, 1916, Journal, Vol. 3, No. 2, at pp. 249–326.

Thousands of lives are sacrificed and millions of dollars in vital capital thrown away every year by inattention, aye, indifference, to these matters. The City of Pittsburgh is a fair example of such indifference to absolutely indubitable facts. That city struggled along for years with the highest death rate from typhoid in this country. A typhoid death rate of 130 per 100,000 was common, and for over thirty years it averaged more than 100. Then they built a filter plant, and what happened? Pittsburgh today has about the lowest typhoid death rate of any large city in the country, and wholly through a purer water supply avoids nine thousand cases of typhoid annually, and saves $4,000,000 in vital capital each year.

Mr. J. M. Diven: Mr. Johnson has given us in compact form information that it would take the ordinary water works superintendent months and years to hunt up. He has given us just the kind of information that we want to lay before water committees, members of city councils, etc. By his strong presentation of facts with reference to water pollution and the necessity for remedying it, he has filled a long-felt want.

Mr. Paul Hansen:[2] Mr. Johnson's paper is the most complete, readable and interesting in point of view that has ever come to the writer's attention on the subject of typhoid fever. The facts are presented so significantly that the paper may well constitute a model and a mine of information for health officials who wish to place the typhoid problem, as well as other health problems, before their respective publics in a way that will make them sit up and take notice.

Under the heading "Health Department Inadequacy," Mr. Johnson discusses in a telling and picturesque way the shortcomings of health departments as they now exist. Every word of this is true, though in many of the smaller communities conditions are far worse than Mr. Johnson has described, primarily because health officers are employed only on a part time basis and at a paltry salary. The speaker knows of instances where health officers are paid the munificent sum of but $5 per annum, and sums of $30 to $50 per annum are not at all unusual. Naturally such an officer does not care to

[2] Chief Engineer State Board of Health, Springfield, Illinois.

alienate any of his private practice as a physician from which the bulk of his income is derived, and, therefore, it is not to be wondered at that he is remiss in enforcing the law.

Most sanitarians have a very clear idea of how an effective local health department should be organized, paid and conducted, but they also realize that it is out of the question to secure the right kind of a health organization at once. It is universal experience in health activities that the only way results can be obtained is to concentrate effort on one thing at a time. This was the policy pursued with reference to the improvement in public water supplies, which Mr. Johnson so strikingly relates and records. So in the case of securing better health administration, we must move one step at a time, and the all-important step to take at the present time is to secure the employment of the full time health officer. The full time health officer will not, of course, entirely solve the problem of health administration, but he will carry us a long way in the right direction. Once the full time health officer is recognized as a necessary institution, those interested in the promotion of health can work for the elaboration of the health department organization. For the present, at any rate, no greater service can be performed in the interest of public health than to urge in season and out of season, the employment of a full time health officer.

Mr. Johnson in the course of his discussion makes some pertinent remarks on the nonobservance of sanitary law, and he might have added that this is in large measure due to the fact that many sanitary laws are poorly drawn, unnecessarily severe, inconsistent as between various communities and various states, and often far in advance of what the general public will stand for. Societies like the American Public Health Association should give attention to the codification of sanitary laws so that there may be greater uniformity of practice.

In connection with certain state sanitary laws relating to the activities of engineering bureaus, a tendency exists to make such laws altogether too lengthy, too drastic, and to include in them too much of the unessential. Too much stress can not be laid upon the necessity of drawing up sanitary legislation with great care so that it will be practically enforceable and will not exceed that which will have the backing of public opinion, for after all, we live in a democracy, in which the government cannot be ahead of the people. To express the situation somewhat differently, a health department should ed-

ucate its public to the need of the law before attempting to introduce the law.

In discussing the control of state boards of health over installation of water supplies, water purification works, sewerage systems and sewage treatment works, Mr. Johnson proposes that state boards of health should not be given power to review plans, but should be required to approve any scheme for water purification and presumably also water works, sewerage systems, and sewage treatment works that are "tangibly guaranteed", whatever that may mean. In the first place, engineers who design works of this character are not in the habit of guaranteeing that their designs will work properly, nor are clients in the habit of demanding such guarantees. In fact, it would generally be considered unprofessional. It then appears that the guarantee must be made on the part of the contractor. This would certainly be unfair when the contractor is bidding upon an engineer's detailed plans, and in most classes of sanitary engineering works it is necessary for the engineer to prepare his plans in detail. An occasional exception to this is current practice in connection with the installation of water purification works. Engineers frequently draw their specifications so that filter contractors can bid on their own plans and specifications for a part or the whole of the work, but as this is not the universal practice, and as water purification works represent only one class of engineering works that must be reviewed by state boards of health, Mr. Johnson's proposal would not seem to be practicable. Furthermore, allowing that it would be possible in every case to secure "tangible guarantees", every engineer knows that such guarantees are often not worth the paper they are written on. In no field has this been more evident than in the water purification field, for it is well known among engineers that a poorly designed, crudely constructed filter plant can be made to furnish a pure water during periods of trial tests and under skillful manipulation though similar results cannot be expected under ordinary operating conditions. Certainly, Mr. Johnson would not propose tying the hands of the state boards of health so that these boards cannot head off such practices as this.

A proper check on possible mischief on the part of state boards of health which do not have competent engineering advice is to have the law so framed that any municipality, corporation, or institution which has occasion to submit plans to a state board of health and which may not regard the requirements of the board as correct or

just, can demand a reference of the matter to a commission of expert sanitary engineers to be appointed and employed jointly by the state board of health and the party taking exception to the board's orders. Such a plan has been adopted in part in the state of Ohio and has worked well to the extent of its applicability.

Mr. Allen Hazen:[3] The speaker wants to commend Mr. Johnson for this statement of the development of water purification and the effect upon the public health. In that connection it may be not amiss to point out that it is only twenty-four years since the first water supply was purified in the United States with the deliberate purpose of reducing the death rate. The water supply of Lawrence, Massachusetts, is referred to. The filter for doing this was designed by Mr. Hiram F. Mills, and the speaker was fortunate enough to be connected with its construction.

Though a young man yet, the speaker has in his short life seen the whole of this wonderful development that Mr. Johnson has described.

It is only a little more than twenty years since we began to talk much about these wonderful possibilities of reducing the death rate by purifying the water supplies. Mr. Johnson will bear out the speaker that the results that have been so far reached have fully justified the prophecy then made and which some of you thought was rather wild at the time. The horrible condition of filthy water and high death rates that ought to have gone with the middle ages and which still did exist twenty-five years ago in the United States, has been eliminated; but there are a great many untrimmed corners yet. There is a great deal of work yet to be done in cleaning up places that have been passed by in the main development.

It may be some time before it will become necessary to treat all the remaining waters that Mr. Johnson spoke of; because when you get a water supply in the Sierra or Cascade Mountains without a human habitation on the catchment area, it is going to be some time before the people will put up money to filter that water, and conditions approaching that exist in quite a number of the remaining unfiltered public supplies of this country.

In that connection the development in the disinfection of water by chemical treatment, in which development Mr. Johnson played

[3] Consulting Engineer, New York City.

an important and creditable part, has resulted in the cutting down of the typhoid rate in communities supplied with waters where conditions are not very bad, and which has particularly made it possible in connection with filters to turn out a water practically safe from a typhoid standpoint.

When the movement for filtration once got going filter plants were built in large numbers. Many of these plants were excellent in design and construction and were efficient, but it is also true that there were others that were and are inferior and hardly deserve to be called filter plants, and these have been built in altogether too large numbers in this country. These plants could not stand up to the service that was demanded of them or turn out the kind of water that is necessary to reduce the death rate to a minimum. In bracing these plants up chlorine and other processes of that kind have played a very important part; and by their aid fair results have been obtained with many badly constructed plants, but the gradual reconstruction of many of these inferior plants is to be expected.

Mr. Hansen deserves to be most cordially commended for what he has said about guarantees. Nothing is more misleading in water works practice than guarantees of efficiency of a plant. It is not necessary to enlarge on that, though the speaker could talk from personal experience for hours on that one point. Mr. Hansen has made the point very well.

Mr. W. E. Miller:[4] The speaker has read Mr. Johnson's paper with a great deal of interest, and regards it as extremely valuable and instructive. There is one thought it suggests that may be worthy of mention here and that is, that some of the ideas that Mr. Johnson has given us ought to be matters of common knowledge, universal knowledge, particularly with respect to the various methods of transmission of typhoid infection. It is going to be very difficult to get boards of health, local or state, to bring about such a complete dissemination of that knowledge as could possibly be done in another way. It seems that the most effective way of widely disseminating some of those ideas is to incorporate them in our system of education. It does not require any study of medicine; it does not require any great amount of time to be devoted to the subject, or the exclusion of work now given; but some of those ideas ought to be given

[4] Madison, Wisconsin.

to children in the public schools, if that is not already being done. There is nothing to prevent us from getting outside of our shells as water works men or as engineers and directing our efforts as public-spirited citizens in the way of urging and demanding the instruction of our children as to the primary precautions that should be taken toward stopping this great and needless waste of human life. There is no better way to do it than to give instruction to our children in the public schools regarding hygiene and sanitation.

Mr. Louis L. Tribus:[5] The speaker sent in a brief written discussion so will not go over any of the ground taken in that. The last speaker has hit upon the practical key-note to this problem. Those of us who have had to do more or less with municipal development, particularly along sanitary lines, have known and have appreciated that it was our duty to try to arrest the danger arising from insanitary conditions due to water pollution, and due to possibilities of danger even where we did not see it, through educational campaigns.

Mr. Johnson's paper has given us perhaps the best compilation and the best presentation of this subject that we have had to date. It contains a great amount of information from all over the field. It is necessary to impress the powers that be to appropriate moneys, not alone from the standpoint of dollars and cents, although that may well be conclusive, but from the moral side also we must impress the grown people and the children over whom they exercise authority with the existence of these dangerous conditions.

We are all of us familiar with the fly crusade. Few realized what a serious matter the fly danger was; but facts were gathered and presented throughout the country. At first these were laughed at; but when additional proofs were presented so that the people could not deny their truth, and convincing pictures of flies alighting on piles of filth, then on the top of the milk bottle, and so on, or passing from stable to table, people began to be impressed with the fact that disease could be transmitted in such ways and then they began to act. We ought to have all of this class of information in such shape that the children will take it in, then their parents will follow, and city and state officials will quickly get into the procession towards duty well done. This is reversing the time honored ways of education, but it is the best practical way today.

[5] Consulting Engineer, New York City.

Dr. D. P. Curry:[6] It is frequently asked why it is that the State Board of Health is not located at the State Capital of Kentucky. The most effective answer is, because our State Board, located where it is in the West Kentucky State Normal School, is in daily contact with three thousand of the future teachers of Kentucky. We know many of them by their name, and they know us rather intimately after several years of contact. So that as the speaker drives out through a remote mountain road in Kentucky past a country school the teacher will run out and call him, saying, "Dr. Curry, stop and tell my children something." We come into personal contact with our future teachers, and that is going to mean a great deal to the generation they are to instruct.

Mr. Johnson touched upon our greatest problem when he spoke of rural communities. Water works men are doing much to improve the general health of the public, but their efforts are mainly confined to large cities. You must think more about sanitation in the country, both village and farm, if your efforts are to reap the greatest recognition. Even in New York City this applies. You can reduce your typhoid rate to the minimum and there remains that residual rate which is so hard to diminish and to locate the source of. Let it be due to milk, carriers, flies or other agencies, you will still find people pointing a finger of suspicion at the water supply. They may languidly swat a few flies, but the business of swatting a water works commissioner is much more alluring. It takes an expert to swat a fly, but anybody can reach a water commissioner and he cannot prove an alibi in the winter time.

But you can assist in spreading the gospel of sanitation to all mankind. The Kentucky State Board of Health has devised a sanitary privy that you should be interested in. It will solve the question of an occasional surface privy upon a water shed; it will improve sanitation upon the dairy farm and reduce your milk borne infection; it will make more clean your summer resorts and camps and make these places more in fact, than as now, in name only, health resorts. And the city profits by having these many avenues of infection stopped.

The Kentucky Sanitary Privy has been improved in design until now one can be built for a cost not exceeding ten dollars for materials in favored localities. It is odorless and costs nothing to

[6] State Board of Health, Bowling Green, Kentucky.

operate. It practically never has to be cleaned out. In seven thousand installations in Kentucky a case of disease resulting from its operation has never yet been discovered. It is known that one or two had to be cleaned out, and that was because they had been used as receptacles for empty whisky bottles. Our department has issued a little bulletin on this subject, and there are twenty-five thousand of them now in the hands of the public printer of Kentucky. The drawings and descriptions are so simple that any school-boy can read them and build one of those privies. In connection with it there is a small septic tank of 200 gallons capacity. It only takes about 5 gallons of water a day to make it operate perfectly odorlessly. There is an intermittent application to the soil once every twenty-four hours of only 5 gallons of water. The speaker will be glad to send any of you gentlemen a copy of our bulletin. The use of these sanitary privies would go a long way toward stopping rural typhoid fever.

Mr. C. Arthur Brown:[7] It seems that the chief value of Mr. Johnson's paper lies in the fact that he has got his talk over. It does not make very much difference how much a man knows, it is of no value unless he can impart it to others. It seems that in presenting this paper in the way that he has, Mr. Johnson has achieved singular success in putting the matter before us in such a way that he has brought to us the whole idea that he had in mind.

The speaker's work is somewhat peculiar in that he has to cover a very large portion of the country in it, and come into contact with a great many cities where this problem has been up in various forms. The company with which the speaker is identified has done a large amount of work in lines somewhat related to water purification, and it seems that the whole value of a thing of this kind is only attained when we can make every one see and realize the facts as Mr. Johnson has produced them. If we can do that we will have no trouble in getting action by the people through their political representatives. There is, as we know, a very great need of more public pressure to induce officials to do that which they ought to do.

Usually water works men are very aggressive in trying to secure such action from political office-holders in their cities; but the people as a whole do not put their support behind the efforts of the water

[7] Sanitary Engineer, Lorain, Ohio.

works man sufficiently to enable him to exert enough pressure to get the officials to do what they ought to do. To give one particular instance where for fifteen years there has been a strong and persistent effort made, and some eight different elections held, trying to get a filter plant for a very impure water supply. There may possibly be three or four more elections before final action can be secured. Why? Because the people themselves have not had the facts placed before them sufficiently strongly and clearly to impel pressure on their part.

This paper by Mr. Johnson is going to be of tremendous value in enabling those interested to create a better public knowledge of how to do it more efficiently than they otherwise could. Mr. Johnson has taken one position on the health board proposition, and Mr. Hansen a somewhat different position. It would appear that the proper solution is going to lie perhaps somewhere in between. The State Board of Health officials have in the past approved plans for purification plants that were not what they should have been; and on the contrary, they have at times condemned plans that were better than those that were finally adopted. There is, therefore, a certain amount of justification for Mr. Johnson's contention that state boards of health should not, after all, be the sole authority in approving or condemning plans of reputable engineers; on the contrary, a great many plans have been submitted which the state board of health have killed because they were not adapted to do that which they contemplated. In this respect the state boards have exercised proper authority and have been very useful.

Mr. Hansen has referred to the state law of Ohio, which is perhaps one of the most progressive in the country; but even under those conditions evils have arisen and plans have been passed that should not have been passed. It is true that a large number of inadequate plans have been adopted and better plans condemned; and it seems that this Association might take up with considerable profit the harmonizing of the extreme views upon this subject, and bringing together the men interested so that they might ultimately work out a solution of the matter that would be better than anything which we now have.

Mr. Hansen also referred to the statement that the operators of the plants under official test conditions can produce or did produce results which the city was thereafter hardly ever able to maintain. Why? Simply because the same amount of brains was not applied

to the problem; that is all there is to it. When a contractor builds a plant and that plant upon completion is subjected to a test, the contractor finds the best man that he can get to place in charge of it and operate it during the test period; and that man produces results so that the contractor makes good his guarantee in the vast majority of cases; because ordinarily a wise contractor knows that he can perform his work before he makes any guarantee. Now if the city were to follow the same plan and put capable men in charge of the plants there would be far less complaint about such plants failing to perform their functions. A good plant in the hands of a poor man may be infinitely less efficient than a poor plant in the hands of a good man; entirely too little thought and emphasis have been laid upon that proposition.

Secretary Diven: A question for Mr. Johnson to answer has been handed in: "Is it permissible to discharge the effluent of a sewage disposal plant into a stream, even when the water in that stream is eventually to be filtered?"

Mr. George A. Johnson: This is a matter which is receiving the earnest consideration of certain state boards of health at the present time. The speaker has always taken the position that a certain amount of pollution of public waters is inevitable and unpreventable. Where sewage treatment works have been installed on a watershed it frequently has been for the purpose of producing an effluent as innocuous as possible, but more often to render the sewage before discharge into the stream as inoffensive as local circumstances required. Thus the stream would digest without nuisance more of the purified sewage than it could of raw sewage.

The question propounded is a highly debatable one, but personally the speaker is willing to express the profound conviction that it is permissible to discharge sewage effluents into running streams or other public waters, provided that in the selection of the point of discharge due consideration is given to nearby water works intakes and public wells; and also provided that the raw sewage is first purified by processes necessitated by local conditions, and that the treatment works are operated as efficiently as climatic conditions and the state of knowledge in the art of sewage treatment will permit.

The speaker believes this to be a thoroughly tenable position. He also believes that to try to prevent the discharge into public

waters of a sewage effluent from a plant which has been built in accord with the best modern practice, and which is efficiently operated, is to attempt the enforcement of an unconstitutional premise. The only remedy is the filtration of all surface waters.

Mr. Theodore Horton:[8] This is a most vital subject and a remarkable paper for which the author deserves a great deal of credit.

By a coincidence the speaker happens to have come from a conference of health officials of the State of New York held at Saratoga Springs, and to have incidentally presented a paper two years ago on the elimination of waterborne typhoid fever in the State of New York. Owing to the prominence of this state in the entire country it might be interesting to know what we have done to eliminate typhoid fever. It bears on a number of questions that have been brought out in Mr. Johnson's paper. For that reason the speaker feels in duty bound to give you these facts.

The typhoid fever curve for the State of New York is divided into two periods; an earlier period prior to 1906, and a later period subsequent to that year. The characteristic of the curve prior to 1906 is an excessive rate averaging about twenty-three. There is no uniformity to it. It ranges from eighteen to as high as thirty deaths per 100,000. The latter period from 1906 to 1916 is characterized by a comparatively low rate, averaging about 12.3, which is about one-half of the rate for the previous period. The rate for last year was 7.4.

Another feature of that curve is that it is practically a straight line from 1906 to 1916, so straight that there is practically no deviation to it, which means that there will be practically no typhoid fever in the state if the curve keeps on decreasing; which of course being an impossibility, arouses a very interesting question as to what will be the future rate of typhoid in the state. It will probably ease off very rapidly so that the curve will strike a horizontal position which will represent the residual typhoid in the state. What is it that occurred about 1906 that made this great difference, and which accounts for this lowering of the typhoid rate since that time? The first reason would be the change in the law. In 1903-1904 the law was changed to give the state health commission greater powers over the pollution of streams; a more important feature, however,

[8] Chief Engineer, State Department of Health, Albany, New York.

is that in 1905 the health department was entirely reorganized. In 1906 an engineering division was established. Prior to 1906 there were practically no investigations made of the water supplies in the state, and nothing systematic in that direction was done, although a great many promises had been made.

So far as water supplies are concerned, prior to 1906, or at that time, there were something like 6,000,000 people supplied with water in the state out of a population of 8,000,0000 or 9,000,000. In 1916 8,000,000 people were supplied.

The number of people in 1906 that were being supplied with purified water was 700,000, in 1915-1916, 6,700,000. In other words, in this latter ten year period the number of people with protected water has increased from 700,000 to 6,700,000, or an increase of approximately 1000 per cent. In percentage of the entire state population it represents an increase from 10 per cent in 1906 to 70 per cent in 1916.

Mr. Johnson's remarks in regard to the state boards of health are presumably meant to be general. So far as the inefficiency of a great many of them is concerned, when we consider the work that our departments have done since their inception, it seems that their efforts have proven that the state departments of health can do considerable along this line.

There are 500 water supplies in the State of New York; 400 of them have been thoroughly investigated. Last year 150 were investigated and by the end of this year the investigations will be completed and a report on practically all the water supplies of the state will be made. These reports are invaluable not only to the department but they are invaluable also as a means of inducing local officials to educate the public to the point where they will bring about the improvements that are recommended. The reports are based upon the studies and investigations, and give full conclusions and recommendations. Following up these recommendations is the work of the sanitary supervisors and local health officers.

The local health officer deals largely with the residual cases of typhoid fever, whereas the state department deals largely with waterborne typhoid. When it is realized that 67 per cent of the total typhoid due to waterborne causes in this state has been cut out in the last ten years it will be understood that in the future the residual cases will have to be largely dealt with, as it will not be possible to make a very much greater further reduction in the elimination of waterborne typhoid.

MR. DANIEL D. JACKSON:[9] Mr. Johnson's paper is of wonderful interest, as has also been the discussion thereof. The paper itself is a classic in that type of literature, as it covers the field most thoroughly and in the fewest and strongest possible words.

The speaker would like to add something regarding the transmission of typhoid by means of flies as related to water works practice. In the spring of 1898 an epidemic of typhoid fever occurred on the watershed of Brooklyn, on a strawberry farm where, during the short period of strawberry picking, about one hundred laborers were employed and lived in tents. It was found that the open latrine used was the source of the trouble, the water supply and the milk having been thoroughly investigated and found to be good. Powdered eosine, a pink aniline dye, was sprinkled in the latrine, and inside of two hours the pink stains were found on the tablecloth where the men had their meals. This stain had been carried by flies from the infected fecal matter to the dining table. The nearby ponds and streams in this section, which were part of the Brooklyn water supply, were at once shut off and allowed to bypass. One of the upper streams near the farm was afterwards found to be badly contaminated, so that a serious epidemic of typhoid in Brooklyn, which at that time had a population of over a million people, was probably prevented.

Another typhoid epidemic not long ago, which occurred at Bay Ridge, and which was thoroughly investigated, was found to be confined to certain particular sections in which building operations were going on, where a large number of mechanics were employed, and no toilet facilities were constructed; in other words, they used the basement of these buildings as privies. This happened to be in exactly the right period of the year for fly transmission. The trouble seemed to develop in groups, close to the building operations, but there was another bunch of spots on our map of typhoid cases, on the other side of the town, nowhere near the building operations. It was sometime before this problem was solved, but it was finally discovered that in this section the houses were on one side of the street, and on the other were a lot of bushes where there was a very large amount of fecal matter, in many cases of diarrhoeal character. They had been putting in a main trunk line to furnish water to that particular section, and the pipe had just been covered up. They

[9] Sanitary Expert, Columbia University, New York.

had had considerably over 100 men working there with no toilet facilities at all, and this was the source of the typhoid in that neighborhood.

Where any large number of laborers are employed during the fly season this is a very important matter to consider, and is often the source of a typhoid epidemic which may afterwards extend to the water supply. So you see the question of fly transmission is very important, and, in building pipe lines, or other construction work, due regard should be given by water works engineers and contractors to the provision of proper toilet facilities. The Sanitary Code of New York City has since been amended to meet this important condition, and every city and town should make such requirements.

Mr. M. N. Baker:[9] The speaker will reserve for the most part what he has to say for a written discussion; but would like to bring out emphatically one point that was suggested by Mr. Johnson's paper which may well be considered an important point, and that is, when we talk of the appropriations that are made for local health board work, and for state health board work, we should take into account, as the matter stands today, the fact that a large percentage of the appropriations that are made in the name of health is spent, not for health protection, but for things that have nothing whatever to do with the protection of health or the saving of life. Many of the communities which make the best showing with respect to the amount per capita of expenditures for health, and many of the states that are highest in the list in that way, are spending their money for the most part for other things than direct health protection work.

It is extremely essential that the local boards of health and the state boards of health, where they are not already doing it, and where the city is not already doing it, should, so far as typhoid is concerned, direct attention to the causes of typhoid; and having done that, to the removal or prevention of those causes; and take measures that will help to eliminate them, instead of spending so much on bare show, as is being done today.

Mr. Horton has told you one way, so far as the departments of health are concerned, for getting at it, and that is for the engi-

[9] Editor, *Engineering News*, New York.

neering division to make a careful study of the water supplies of the state; and when that is done in other States as well, we will doubtless see where the high typhoid rate now prevails and will be able to make efforts toward a material reduction of it.

Before the speaker finishes you will see why he has referred to Mr. Horton. It always gives him a thrill of pleasure when he hears Mr. Horton speak. We got him, at Montclair some twenty years ago, to carry on an investigation in our local health board work. We concluded that instead of taking some local doctor of middle age we would pick out a young man who had some enthusiasm in the work and who would take an active interest in it, as the health board had been suffering from incompetent work of incompetent physicians. So we decided that we would apply to Professor Sedgwick, of the Massachusetts Institute of Technology. We did so, and he recommended to us a young man who had been trained in sanitary engineering. From that beginning, and by following that policy, we obtained some remarkable results in the Montclair health board work, and about the same time a number of other communities adopted the plan of taking on engineers instead of health officers for local health board work; and as conditions were at that time, there was no training whatever that fitted men for such work; it was being done by doctors entirely. From that time the custom spread of appointing engineers for local health officers, and that has continued until now there are many cities that have anywhere from one to a considerable number employed. Detroit today has four. Mr. Saville has recently been made Director of Sanitation at Dallas, Texas; and the good work is still going on.

Now with every state board of health it is not, of course, meant to give the engineers the whole credit; but it is largely due to the fact that the engineers with sanitary training have been put to work in connection with state boards of health in the country that we are cleaning up our water supplies and reducing typhoid fever as we are.

President Hill: Some of the state boards of health in this country should try to correlate the responsibilities of those discharging sewage into a stream and those who take water from this stream for drinking purposes. The speaker is impressed by the drastic requirements of some state boards of health with regard to

sewage disposal, all of which tends to retard the results to be achieved.

It is not believed that a sewage disposal plant may be reasonably expected to turn out drinking water, but that it should be so designed as to keep our streams in proper condition; that is, to keep them sweet, to maintain the oxygen content in proper proportion, to obviate visual and olfactory nuisances, and to maintain the water in the stream in such condition that the filter plant may handle it with a reasonable degree of care and efficiency.

There is much work to be done in this line if we are to get the coöperation of small communities, factories, mill owners and others who are required to build sewage disposal works and if we hope to accelerate cleaning up our streams.

Mr. John J. Powers:[10] The speaker would like to call your attention to the fact that 800,000,000 people travel on the railroads, and 500,000,000 people travel on the boats of this country, and their excreta are deposited on the highways of commerce along the railroads, or into the waters of the several States. One of the practical things that you could do would be to call the attention of your representatives in Congress to the necessity for preventing the railroads of this country from scattering excreta and infection along the entire course of their roads. Many times men look for the foci of infection and they wonder where it is; typhoid fever appears where there has been no typhoid fever in the neighborhood, or scarlet fever, or diphtheria, and they wonder where it comes from. It may have been blown in by the winds from off a railroad track, having become dried and reduced to dust; or it may have been washed down in the stream by the rain. Mr. Johnson's statement as to the danger of urine pollution is extremely valuable, because nearly every one travelling for any length of time in a railroad car uses the urinal; and also the statement of Mr. Jackson as to what he found practically all along the line where they were laying a water pipe, in the way of surface pollution by men who were not under proper supervision.

Mr. Rudolph Hering[11] (by letter): Mr. Johnson has given us a very clear and readable paper on the most important facts

[10] Elizabeth, New Jersey.
[11] Consulting Engineer, New York City.

which relate to typhoid fever from a sanitary engineering viewpoint. For the water works engineer, it is one of the best accounts he has to help him know and appreciate the origin, the spread and the prevention of this scourge.

To be of assistance in any direction it is necessary to thoroughly understand our subject; and when this is presented in so attractive and forcible a manner as Mr. Johnson has done, it cannot fail to be of much value. He well points out that the most efficient means with which to combat the typhoid evil is education. No truer words can be said than that "education, respecting health matters, is the light which will eventually lead us out of the insanitary wilderness". In fact, we may say of all troubles that education is the best means for removing or alleviating them.

According to Mr. Johnson's advice this education must extend to both the governing and governed classes, to the city's officers as well as to the citizens. Those persons who are responsible for furnishing a community with a good water supply should keep closely in touch with the latest progress that is being made in this branch of engineering both in theory and practice. But it is even more important that the general public be educated in many matters relating to it, because an ignorant citizen by a single foolish act can do more mischief than many city officers may be able speedily to remedy. We must, therefore, educate both those who control the design and operation of water works so as to prevent the spread of typhoid fever, and also those who use the water and who are sometimes the more responsible for the occurrence of epidemics, because of an innocent ignorance as to how they originate, spread and can be prevented.

It is true that we have now succeeded in preventing much typhoid fever by the proper use of anti-typhoid vaccine. This expedient may become in time as valuable as the anti-smallpox vaccine, but this expectation must nevertheless not hinder us from imparting the education now practicable regarding the dangers that face us and how they can be avoided. Such education will help at once.

The writer trusts the time may not be far distant when all surface waters will be purified before they are delivered to consumers, and when no waters will be delivered in a natural state, except spring or ground water which nature has herself purified.

The cities in most of the western countries of the European Continent have for many years adopted this rule, and it has been very

effective in reducing and almost exterminating typhoid and many diarrheal diseases. Let us hope that in our country we will also soon rise up to the same level of civilization, and supply our citizens with none but either pure ground or spring water or, if these are not available, with purified surface water, and not subject them to the danger which might come from the 20,000 typhoid carriers, mentioned by the author as living in the United States, one of whom can, by an innocent but improper act along the banks of any water supply brook, produce a typhoid epidemic in the town below.

Dr. George A. Soper[12] (by letter): Mr. Johnson's paper is an eloquent plea for a clearer understanding of the typhoid peril and of the part which the filtration of public water supplies may take in reducing it. He says that the typhoid rate, which averages 20 per 100,000 in American cities, can be reduced to 14 by filtering the water supplies which are not already filtered, and that this would cost about $100,000,000, which is equivalent to an annual expenditure of about $12,000,000. These figures are understood to be rough approximations and are given to illustrate the part which filtration can play in eliminating one of the most familiar and costly diseases. Speaking generally, it can be reduced about a quarter.

Mr. Johnson could have made out a stronger case for filtration if he had cared to set forth its other advantages. He could have shown that the general death rate, as well as the typhoid death rate, generally falls when filters are put into service and that the cleaner, clearer, brighter water which is supplied produces many benefits some of which have a large money value. Accurate estimates of these advantages are impossible, but it is not unreasonable to suppose that the aggregate money returned to a town from the installation of filtration works greatly exceeds that represented by the saving in lives from typhoid, large as that is.

The author of the paper has performed a public service by frankly acknowledging that the capacity of filters is limited in reducing typhoid. Certainly they cannot prevent more cases than the water supply can produce. Some persons will be disappointed to find him saying that the disease cannot be eliminated alto-

[12] Chemist and Engineer, New York City.

gether by filters, but the paper shows clearly why this statement cannot be made.

In making what some will regard as a low estimate of the amount of saving possible, the author of the paper places himself fairly in line with recently ascertained facts. There has recently been much progress in the study of typhoid. More has been learned in the last few years of the causation of this disease than had been found out in all the time since it was first recognized.

The most important fact to remember is that typhoid is essentially a contagious disease. It is only incidentally a water borne disease. Its germs live perpetually in the bodies of some persons who are otherwise in perfect health, and no medical treatment thus far devised can exterminate them. In any community there are generally more persons in seeming good health who are producing typhoid germs than there are patients suffering in bed from the disease. From these living and moving centers the germs radiate in various directions. The usual means of transmission are short and direct. The germs are literally handed from person to person. Nurses commonly perform this office. The bacteria, fresh from the body of one person get onto the hands and so to the food of another. This is close range infection, the most dangerous and perhaps the most frequent cause of typhoid fever.

So common is the occurrence of close range infection that it is always wise to seek a strictly local cause in an outbreak of obscure origin. Upon this principle many epidemics have been accounted for, including the historic outbreak in which Typhoid Mary was discovered.

In spite of the notoriety which has attended certain aspects of the Typhoid Mary case, the history of that unfortunate woman has never been told to water works people with that accuracy and fullness which is desirable, and this is not the time to tell it. It is sufficient to remark that, contrary to the opinion of some, this person has never been exploited for the benefit of others, but has brought upon herself a large part of the public attention which she has received. Finally, upon securing her freedom from the New York City department of health, she went back to her former and fatal occupation of cooking and produced a number of fresh outbreaks, one of which, in a hospital, led to her second arrest and present detention by the health authorities. Aside from its

being the first instance of a typhoid producer discovered in America this case is interesting for the way in which it was handled by the department of health and the complete justification which the subject has herself given for her unusually severe treatment.

The paper which we are discussing calls attention to some remarkable peculiarities about the incidence of typhoid which have always puzzled those who have sought to explain them, and which, in spite of some excellent recent work, still appear as difficult to account for as they ever did. One of these is the seasonal distribution of typhoid. Another is the preponderance of the disease in rural as compared with urban districts. A third is the excessive rate among the colored race. A fourth is the large amount of typhoid in the southern as compared with the northern sections of the United States. A fifth is the surprising way in which the rate may fall in seeming response to a sanitary improvement which otherwise appears to have nothing to do with it. The explanations of these phenomena given by Mr. Johnson are probably as good as any which could be offered at the present time, but none is completely satisfactory. They should be regarded as sufficient only until more facts are collected and more definite conclusions drawn. It is in this sense that they appear to have been put forward. It may satisfy the imagination to ascribe real danger to cheese, butter and fresh vegetables, but there is a regrettable dearth of information actually establishing these possible means of transmission as real dangers.

If typhoid fever is to be eliminated, it must be by seeking to reach the germs not alone by such long range measures as filter plants, but by measures close at hand. Especially should an effort be made to reach the germs at their source. It must be recognized that they breed in people, rarely in things. These people must be found and surrounded with effective, though not irksome precautions. This has been done abroad and can be done here. It is essentially the work of the health officer, the nurse and the physician. Above all, it is the duty of every person who has had an attack of typhoid to ascertain whether he has become a carrier, and if so, what he should do to protect others from contracting the disease from him.

It is noteworthy that Mr. Johnson has merely mentioned what is probably the firmest defense which the individual can provide for himself, vaccination. Anti-typhoid inoculation affords a well

nigh impregnable defense against typhoid. It is compulsory now in all the armies of Europe except that of England. Its protective effect among our own troops has been abundantly shown.

In conclusion, the question may fairly be asked: what is to be the final result of all the work which is being done for the elimination of typhoid? Can it ever be utterly exterminated? Nobody can give an authoritative answer to this query, but those who are best informed hold the view that typhoid like typhus and other filth diseases with which it was once associated, will disappear from the civilized parts of the world under normal conditions of peace and prosperity to reappear only under conditions of exceptional social stress. Better regard to cleanness and order, to nourishment, rest, recreation and intellectual enlightenment, has driven most of the pestilential diseases from most countries, so that even the names of some are not recognized in those places where they once brought terror.

But repeat the conditions of life in which cholera, plague, typhus and typhoid were once rampant, and nothing but the most heroic efforts of science can keep them down. This fact has been well demonstrated by the remarkable thoroughness with which the Germans have fought typhoid in the present war, and by the alarming outbreaks of typhus and other contagious diseases which have occurred where adequate precautions against them have not been taken. Peace brings no greater blessing than the opportunities it offers for the progress of civilization, and war has no consequences so disastrous as the impediment which it offers to that progress.

Dr. William H. Park[13] (by letter): Mr. Johnson's paper covers a most important subject and does it in a very comprehensive way. Until lately all of us felt ashamed of our typhoid death rate. The record of the last ten years shows splendid progress, but, still, as Mr. Johnson shows in his paper, much remains to be done. Undoubtedly water is the chief danger and milk the next important one. If the public can only be brought to appreciate the amount of sickness still caused by infection carried in water and milk, and that it can be so absolutely prevented, it seems as though a demand must arise that all water and milk used for drinking purposes be rendered safe.

[13] Pathologist, Health Department, New York City.

The members of the American Water Works Association have done splendid work in rendering much of the water supply of America safe, and the writer hopes they can see, in the near future, no water supply consumed while still unsafe.

Mr. John A. Vogelson[14] (by letter): The author has gone so thoroughly into the subject that the only points that could be discussed are those relating to devising practical means for reducing the "Toll", and here, it seems the attainment of the desired end is through a thoroughly awakened civic conscience, which will not permit the doing of those things which are proven harmful to public health.

Referring to Mr. Johnson's quotation from Dr. Freeman that typhoid is now "a problem of administration", probably that expresses the situation concisely in so far as governmental activities are concerned, when administration is used in a very wide sense to collectively express all acts of government, legislative, executive and judicial, in dealing with this problem, and not to the detail of some particular branch of the executive function. For all of the functions cited are inseparable, and some of our errors arise in not giving due weight to the function with which we are not directly associated.

Health administration in its practical application is in large part the restraining of people from committing harmful acts, and those acts, in many instances, are the outgrowth of customs which, until recent years, were not known to be harmful. Changing the customs of the people is an administrative task of no small magnitude.

Again taking up administration in its narrower sense, as applied to private affairs, the administration necessary for the reduction of the typhoid "Toll" should be governed by the policy that dividends must not be obtained by any risk of safety.

Just a word as to the author's thought that health departments should approve plans on the guarantee of the applicant that the proposed works will be of a certain standard efficiency, consider the files of the Patent Office, also the problem of correcting defective work once it is built, especially when tax payers' money must be obtained to correct the defects.

It is most fitting that the typhoid situation should be so

[14] Chief, Bureau of Health, Philadelphia, Pennsylvania.

thoroughly presented to the Water Works Association, and the writer congratulates the author on his timely paper.

Mr. Charles Saville[15] (by letter): Public health officials throughout the country owe a debt of gratitude to Mr. Johnson for collecting and tabulating such a vast amount of data regarding the prevalence of and losses from typhoid fever in the United States, and for presenting so forcefully the serious public health aspects of this problem.

Among the principal factors affecting the prevalence and spread of typhoid fever mentioned by Mr. Johnson are: (1) Pollution of public and private water supplies. (2) Typhoid carriers. (3) Infection from contaminated foods. (4) Infection through the house fly. (5) Failure of the average citizen to appreciate the unhealthful aspects of filthy surroundings, and his responsibility in this respect to the other members of the community in which he lives.

In the matter of water supplies it is now pretty generally recognized that every community should have an uncontaminated public water supply, which in many instances means providing a suitable purification plant. It still remains, however, for public health officials and sanitary engineers to convince municipal administrators that water purification plants require expert supervision in order to produce under all conditions a safe drinking water. The public health official likewise has the more or less difficult duty of convincing the members of his community that it is to their interest to use the public supply in preference to individual wells and cisterns on their own premises.

In the city of Dallas, a very considerable proportion of the typhoid fever cases during the past year have, without doubt, been due to the use of contaminated private water supplies on property which was supplied with city water.

Typhoid carriers are without doubt a very important factor in the spread of typhoid fever. Unfortunately, however, the average small community is not equipped to detect and to properly control such carriers.

The spread of typhoid fever no doubt takes place, to a certain extent, through contaminated foods, particularly raw milk, and much

[15] Director of Public Health, Dallas, Texas.

is being accomplished at the present time in the majority of our cities toward the proper control of the food and milk supply. One of the most serious factors, however, in the spread of this disease is the common house fly, which breeds in stable manure, and frequents unprotected privy vaults, finally visiting in large numbers our kitchens and dining rooms.

The excellent results mentioned by the author as having been secured in Jacksonville, Florida, through the simple means of making all privies fly tight have been duplicated in Richmond, Virginia, and a few other southern cities.

During the past year in Dallas one of the principal activities of the health department has consisted in abolishing unprotected privies and forcing the owners to provide sewer connections. During a period of ten months over seven hundred of these closets have been abolished, and it is felt that no phase of the work of the health department has been of more importance. This work, however, as well as that of making all necessary dry closets fly tight, continues to be extremely difficult on account of the lack of coöperation of the people, and the still prevalent idea that personal liberty comes before community responsibility.

Perhaps the principal activity of a modern well organized health department is its educational work. In this connection the writer cannot help wishing that much of the information in Mr. Johnson's excellent paper might be made available to the general public instead of only to the members of this association who already have an appreciation of the importance of the subject. The suggestion is offered that excellent results might be secured by having a brief summary prepared of all such papers, for distribution to the press throughout the country. With this in view the writer recommends that the association create, if provision is not already made for this, a committee on education, whose function would consist in furnishing to the general public such portions of its proceedings as would be instructive and helpful to the people at large.

Mr. Franz Schneider, Jr.[16] (by letter): A vigorous exposition, such as Mr. Johnson's, of the status of this country's typhoid problem, has particular value for the reason that this problem is symbolic of the country's interest in the welfare of its citizens. As Mr. John-

[16] Sanitarian, Department of Surveys and Exhibits, Russell Sage Foundation, New York City.

son has pointed out, typhoid is a thoroughly preventable disease. Our knowledge of the disease is remarkably complete; we have known the responsible bacillus for 36 years; we have a very satisfactory knowledge of the modes and sources of infection; and we have a prophylactic of proved value. In addition, we have had absolutely convincing demonstrations of the efficacy of the recognized methods of control; we have seen the disease eliminated from the army, and again and again have seen the reduction of the death rate following purification of a polluted water supply. Hardly a better example could be found of the astounding power gained by sanitation over disease. Yet Mr. Johnson is able to tell us that 300,000 persons suffer from typhoid in this country each year, and that of these 20,000 die. That is certainly something to think about.

We know, however, that the situation is improving. Year by year more polluted water supplies are being purified, more health departments are being improved; and the typhoid rate is falling. At the same time, a disgracefully large number of polluted water supplies still exist, and the ordinary city health department, with its per capita appropriation for health purposes of 22 cents a year, is still a shocking example of municipal neglect. In a similar way, Congress apparently considers $3,000,000 an adequate appropriation for the federal public health service; but judges it wise to spend $20,000,000 each for five battle cruisers, and to go in for a navy building program calling for an expenditure of $160,000,000. Such a small proportion of the public funds, but 1 or 2 per cent, is spent for health that it is difficult to escape the depressing conclusion that the interest of our governments in the public health is relatively slight.

Mr. Johnson's emphasis on the importance of contact infection is certainly justified. The contagiousness of typhoid is one of the things about the disease that the public needs most to know. As water supplies are purified, wells and privies eliminated or regulated, and milk supplies pasteurized, contact infection becomes relatively more important. In a city with a good water supply and no special privy problem, it is probable that a third or a half of the cases may arise through direct contact. To prevent this kind of infection, use of the typhoid prophylactic and public health nurse are especially valuable. The city health department should visit reported cases promptly, and revisit them as necessary. Nurses are better than inspectors for this purpose; they are better fitted to instruct the family in proper care of the patient and prompt and efficient bedside disinfection of the discharges, and they cost less.

The best single way to work for the elimination of typhoid fever in this country is to work for better health departments, departments with adequate appropriations, full-time health officers, public health nurses, and laboratories. With such departments we shall have closer scrutiny of public water supplies, and better supervision of cases of the disease; we also shall have a strong force in each community working to educate the public and its representatives in the opportunities in, and the importance of, modern public health work.

Mr. Robert B. Morse[17] (by letter): The writer is more than ordinarily interested in Mr. Johnson's paper on "The Typhoid Toll" as, in 1912, it was his duty to organize the engineering division of the Maryland state department of health, and since then to direct its work and to watch the operation of one of the more recent and comprehensive state water supply and sewerage laws. Mr. Johnson emphasizes the importance of such laws for supervision over the character of water supplies in connection with the control of typhoid fever. However, he feels that a model water supply law would not require approval by a state health department of the physical features of water purification plants, giving as his reasons the possible inefficiency, arbitrariness, prejudiced attitude, or dilatory tactics of the public health officials.

The writer confidently believes that the omission from state water supply and sewerage laws of the clauses requiring the approval of all engineering details of plans and specifications would cut the very heart out of such laws and would defeat their object. He has no sympathy with those officials who, through provincialism or other cause, will not approve accepted methods of water purification and sewage treatment which are suitable for the case under consideration.

It is not sufficient to say that, because state officials may be inactive, inefficient or arbitrary, the law should be changed. Rather, the appropriation for carrying out the law should be increased, so that capable men could be obtained and so that a sufficiently large force could be employed to insure against delay in reviewing plans.

Concerning the question of delay, Mr. Johnson says that a time limit within which plans must be approved is necessary and that "As these laws now read the approval of such projects may, for one reason or another, be delayed indefinitely and to enforce action

[17] Chief Engineer, Maryland State Department of Health, Baltimore, Maryland.

mandamus proceedings provide the only way out of the difficulty". In the view of the writer a time limit would be impracticable, since the projects which are submitted for approval are widely varied in character and magnitude and require varying amounts of study, investigation and detail work on the part of the health department engineers. Moreover, a set of plans may be submitted when there are numerous projects already before the health authorities, in which case it is impossible to pass upon them as quickly as otherwise.

The Maryland law makes an attempt to deal with the matter of promptness in passing upon water supply or sewerage plans, for it states that "Whenever application shall be made to the state board of health for a permit under the provisions of this Section, it shall be the duty of the board to examine the application without delay, and, as soon as possible thereafter, to issue said permit, disapprove the application, or state the conditions under which said permit will be granted." In the rules and regulations which the Maryland state department of health has issued for the submission of plans, it is stated that a permit may not be expected by an applicant within two weeks after the date of the application, although in many cases permits for minor projects are actually issued within a shorter time. Sometimes those desiring permits for construction work are themselves at fault for any delay that may occur, for they have been known to have had plans finished for weeks, submitting them to the health authorities only when contracts are about to be let. Moreover, engineers many times pay little heed to the regulations for submitting plans and do not transmit the proper data upon which an intelligent review can be made. Whose fault is it then when changes have to be made and delay results?

Returning to the question of approval of detail plans, it would seem unfair for the health department to commit itself to the approval of any process unless it is allowed to pass upon the design to be used in connection therewith. Good results depend upon good engineering design, and if competent engineering judgment is not used in the preparation of plans, such results will not be attained. If satisfaction did not ensue, delay and unnecessary expense would be met with in having suitable changes made. And if the engineer of the health department had no supervision over the details of such alterations, it might be a long while before the structure would be in proper operation. If the highest class of engineering services were always available for the preparation of plans, there would be less

need of the state engineer passing upon the physical features of the design submitted to him. Unfortunately, most small towns, and many of the larger ones, believe that the more competent engineers' services cost more than they can afford, and when they engage an engineer he is more than likely to be a local man with no particular aptitude for the work at hand. On the other hand, there have been some instances in the writer's experience where engineers of good standing have been inclined to give too little personal attention to small jobs, leaving them to subordinates with limited experience.

A state water supply and sewerage law, like a building law, is for the benefit of the public health and safety, and it seems to the writer that it is just as important for the engineer of the health department to pass upon all the phases of plans for water supply and sewerage improvements as it is for the building inspector to pass upon all features of building construction.

It is impossible to predict just what parts of an engineering design will have a bearing upon the public health, in any particular case, but the manner in which the health of a community may be affected is sometimes not apparent when the plans are submitted. For instance, some years ago the authorities of a small Maryland town gave a long-term franchise to a private party for the construction of a water system. At that time there was no law requiring the submission of plans to the state health department and the system was installed with small pipes and fire hydrants. Two years ago a bond issue for water and sewerage systems was voted by the citizens. If the existing water supply had been adequate as far as it went, the town would have purchased it as a nucleus for the new system, but the town could not afford to obtain and discard it and was prevented by law from putting in its own system without making an agreement with the owner. As a consequence, the community has been prevented for two years from obtaining the advantages of either an adequate water supply or a sewerage system.

The writer believes from his experience in Maryland that, in the interest of both public health and economy, the citizens of the state need the protection of the health department in reference to all details that enter into a water supply or sewerage improvement. In this state a law to this effect was passed early in 1914 and its operation has been attended with considerable success and with little real opposition. Everything possible is being done to encourage the installation of water supply and sewerage improvements. It is be-

lieved that work under this law has already had its effect upon the typhoid death rate in Maryland, particularly outside of Baltimore city, although it is still considerably higher than it ought to be and much higher than in many states where laws of the same character have been operative for a longer period. During the five years from 1909 to 1913 inclusive, the typhoid death rate in Maryland outside of Baltimore city was 39.8 per 100,000 population, in Baltimore 28.2, and in the state as a whole 34.8. In 1914 the corresponding figures were 25.8, 22.4 and 24.38, while in 1915 they were 26.4, 21.9 and 24.48.

Nearly all of the public surface water supplies in Maryland are now purified and it has been even necessary to disinfect some of those derived from underground sources. Out of 842,500 people served by public water systems, 745,000 or 88.4 per cent drink treated water and only 97,500 or 11.6 per cent use untreated water. Of the total population of the state, 62.1 per cent are served by public water systems, while of these 54.9 per cent use treated water and only 7.2 per cent untreated. In 1912, when the engineering division of the state health department was organized, there were only seven water purification plants in Maryland, while at present there are twenty-one, besides which six institutional supplies are treated.

There are, upon the average, twenty persons engaged upon the engineering work of the Maryland state department of health. Four district offices, besides the main office, are maintained, and the resident engineers in charge of these are enabled to come in close contact with the people in all sections and do much to encourage the movement for better water and sewerage services.

The comprehensive manner in which Mr. Johnson has treated the typhoid fever question in his paper is most instructive and the writer is pleased that he points out so clearly the value of centralized control in the reduction of the prevalence of this disease. He wishes that this phase of the subject might receive more frequent discussion.

Dr. Harvey W. Wiley[18] (by letter): The writer read a paper before the Massachusetts state board of agriculture during the holidays, in which he made a comparison of rural and urban health conditions, and particularly made a study of the typhoid rates,

[18] Director Bureau of Foods, Sanitation and Health, *Good Housekeeping Magazine*, Washington, D. C.

much along the same line as Mr. Johnson has followed in his paper. This paper has not as yet been published.

Mr. Johnson has put the matter into the form of graphic charts, which are much more readily comprehended by the reader than the ordinary statistical form; and is to be congratulated on having adopted this method of illustration. He is also to be congratulated on having put together this matter in such a compact form. In the manuscript of a book, which is now in the hands of the publishers, on beverages, the writer has treated the matter of the carrying of disease by water in some detail. Therefore, he is perhaps better informed than many others because of the recent careful study given to the questions which Mr. Johnson has so ably discussed in his paper. The best discussion of it is to commend it to everyone who is interested in the protection of our people from typhoid infection. It is not likely that all of us in the near future will be vaccinated against typhoid. We must depend, therefore, as a people, more upon sanitary control of sources of infection than on immunization by the introduction of dead typhoid bacilli into the blood. The writer believes that typhoid is on the wane; and is looking forward to a day when it will be as rare a disease, even rarer than smallpox. It is encouraging in the city of Washington, which for many years represented a continued typhoid infection, to find that the number of cases reported last week was only three, and that the total number of cases under treatment was only thirty-two. This of course is entirely too much, but when compared with Washington two or three years ago it seems like an almost complete victory.

Dr. E. C. Levy[19] (by letter): The paper of Mr. Johnson is a very complete summing up of the typhoid situation as understood today. There can be no question that the work which health departments have done in connection with typhoid fever alone has resulted in a financial saving greater than what these departments have expended for all purposes. Everything else which they have accomplished is therefore "velvet".

It is exceedingly gratifying to find that work which was done in Richmond in 1907 and 1908 is now everywhere accepted. At that time water and milk were held to be the great carriers of typhoid fever. Study of the Richmond situation brought out the fact that these factors were not the chief ones with us. The average annual

[19] Chief Health Officer, Richmond, Virginia.

typhoid fever death rate in Richmond for twenty-six years, 1880–1905, prior to reorganization of the Richmond health department had been 77.8 per 100,000. In only four years had the rate been below 50, and the lowest rate in any year during this period was 43.5.

After one year's study, the conclusion was reached that spread from local foci of infection was the main cause of our typhoid. There were at that time about 4500 privies in the city of Richmond, scarcely one of which was even in decent condition. The board of health adopted rigid rules and regulations governing the construction and maintenance of privies and put special inspectors at work getting into proper condition all privies on premises which could not be reached by water and sewerage services. The city spent $1,000,000 for the extension of its sewerage and water systems. As a result of this, the typhoid fever death rate immediately dropped to 24.1, with the water supply entirely unchanged. This was in 1909. Since then the rate has steadily fallen, year by year, until in 1915 the rate of 12.3 was reached, which is phenomenally low for a Southern city. This rate meant 19 deaths. Of these 19, 6 were contracted outside of the city. Of the remaining 13, the diagnosis was exceedingly doubtful in 4 cases, leaving only 9 deaths from typhoid fever contracted in Richmond in which the diagnosis was certain. This was equivalent to a rate of 5.8 per 100,000.

It cannot be too strongly urged that typhoid fever in the North is usually a question of the water and milk supply, while in the South it is very largely a question of spread from local foci of infection. The Southern typhoid is mostly summer typhoid, and summer typhoid even in the North is seldom due to water. A pure water supply is of course as important in the South as it is in the North, but its relative importance in comparison with other means by which typhoid is spread is greater in the North than it is in the South.

Mr. Johnson's effort to show the actual financial profit to be gained by controlling typhoid should be brought to the attention of all municipal and state authorities having control of appropriations. The writer cannot agree that the death rate of any community can be indefinitely lowered by spending more money, but there can be absolutely no question as to the ability of the health authorities to banish typhoid completely if only they are given sufficient appropriations wherewith to bring about this result. Certainly most health officers would only too gladly undertake such a contract.

A movement of this kind, however, would have to be nationwide. If even forty-seven of our states were to undertake this work, it would result in failure if the forty-eighth state did nothing and served as a source of cases.

In some ways it is unfortunate that the only disease against which special societies, national, state and municipal, have been organized should be the one disease most difficult of control, namely, tuberculosis. There can be no question but that one-tenth the organized effort, the general interest and the actual expenditure of money if directed against typhoid fever would by now have practically eliminated this disease, while in the case of tuberculosis we often doubt whether we have even yet gotten to the point of knowing what to do.

Dr. Charles V. Chapin[20] (by letter): Mr. Johnson's paper is a timely and valuable contribution to the subject. It is interesting that some of the most valuable books and papers relating to typhoid fever have come from non-medical men, and it is pleasant to note how the scientific training of the engineer prevents him from taking a narrow view. All of us, whether engineers or medical men, alike think of infected water as the chief factor in the causation of typhoid fever, and so it has been in the past. Fortunately there has been most remarkable progress, and in a very considerable number of our larger cities, the influence of the public water supply, formerly of supreme importance, has become nil, or very slight. This paper should be the means of inciting to still further progress, and it is hoped that the time will come in the not very distant future when public waters in the United States, as in some parts of Europe, will have little or nothing to do with the causation of typhoid fever. It is difficult for some English health officials to believe in the tremendous importance of water borne typhoid fever in the United States. A municipal health officer living in a city where the water supply is properly safeguarded naturally turns his attention to sources which there are more important. It is gratifying that the engineer also fully appreciates the importance of the removal of privies, the protection of food, particularly of milk, the skilled investigation and supervision of all cases and last, in well sewered Northern cities, the control of the house fly.

[20] Superintendent of Health, Providence, Rhode Island.

Dr. Rupert Blue[21] (by letter): The extent and importance of the problem of typhoid fever have been clearly and convincingly set forth in Mr. Johnson's paper. As further remarks along these lines can be scarcely more than repetition the writer will take this opportunity for describing very briefly the character of the studies which the public health service has been making in connection with rural sanitation.

In these investigations it has been the object of the department to ascertain with a reasonable degree of accuracy the sanitary conditions which prevail in the rural districts of the United States, and to determine what improvements would result from a detailed survey of these conditions under the direct observation of the people immediately exposed to and responsible for them. In the course of these studies the rural dwellers are urged to take the well known precautions necessary for their protection against disease, and local health organization and administration are encouraged in order that local full-time health officers may be employed by communities and depended upon to improve sanitary conditions.

In those districts selected for special study the usual procedure has been to inform the citizens of the purposes of the survey by means of circular letters signed by the Surgeon General of the Public Health Service and endorsed by the state health officer.

A canvass and survey of all the homes outside incorporated towns are then made, especial attention being given to the disposal of excreta, and to water supplies, refuse disposal and foods.

Sanitary surveys of all incorporated towns are made, and similar attention is directed to the disposal of excreta, stable manure, garbage, and to water and food supplies.

Literature on sanitary subjects is distributed to practically all homes, and public meetings and lectures on sanitation are held in as many neighborhoods and as frequently as seems advisable. The lectures are usually illustrated with stereopticon slides.

Following the survey of each town a report of the findings together with specific recommendations is made to the local authorities. Such reports also include inspections of schools, churches, railroad stations, post offices and stores.

An important part of the work consists of resurveys of towns and revisits to rural homes in order to note the sanitary improvements

[21] Surgeon General United States Public Health Service.

which have been made since the first visit and to indicate further improvements needed.

During the past two seasons, a canvass and survey of 47,971 homes has been made and 8842 of these have been revisited.

The vast majority of the people interviewed were found either to be entirely uninformed or to have very erroneous ideas about the source and the modes of spread of typhoid fever and of other excreta-borne infections, and about the principles of preventing dangerous pollution of the soil and of water supplies.

In all of the districts surveyed, however, marked improvement had been made in the methods of disposal of human excreta, in water supplies, and in screening to prevent flies from having access to foods.

In several of the counties over 25 per cent of the strictly country homes made in the course of the surveys radical improvement in the construction of privies.

Much remains to be done, however, and under existing dietary and sanitary conditions there will be in our rural districts in 1916 thousands of deaths and hundreds of thousands of cases of illness which are preventable by measures now as definitely known as are those for the prevention of the spread of yellow fever or smallpox.

Mr. Cornelius C. Vermeule[22] (by letter): The author has collected and digested a large amount of valuable data concerning the connection between typhoid fever and domestic water supply, purified and unpurified. The case for filtration of public water supplies is admirably presented, and in the opinion of the writer fully sustained. No achievement of modern sanitary engineering is more marked or better proven than this. The diagnosis of typhoid is not likely to be erroneous as the bacillus is identified with much certainty. There is no question that the filtration of potable water has been the principal agency in the reduction of this disease, although certainly other sanitary measures have been of assistance. The progress made through filtration is brought home to many of us when we reconsider views of a quarter century ago, which some of us were unfortunate enough to put on record. The pain of acknowledging that there was a time when we did not know everything, however, is always greatly mitigated by the proud realization that we have continued to learn.

[22] Civil Engineer, New York City.

By way of further palliation, the writer will venture to quote some words of his own which in his opinion have been amply justified by later experience. They referred to uncertainties in the interpretation of both chemical and bacteriological analyses as matters stood twenty-five years ago, but are not entirely inapplicable to present conditions:

> Unfortunately these uncertainties are sometimes made the basis for belittling or ignoring the warnings of such analyses, and frequently at the expense of large communities. The very reverse course would seem to be the wisest and most sensible one. Our ignorance in these matters should only breed the greater caution. In the absence of better data, we may perhaps go so far as to say that no source of supply which is repulsive to the natural instincts of intelligent persons should be tolerated. The senses of sight, smell and taste should always be exercised for our protection in the absence of other means, and only the most thorough and conclusive proof that such repulsive waters are not deleterious should be sufficient warrant for continuing their use.

Not the least of the advantages of filtration has been the improved appearance of the water, which has the same beneficial effect on the user as savory and attractively served food, while it is an invitation and incentive to greater cleanliness and a better appreciation of all sanitary measures.

Mr. Johnson quotes an average value of $3600 for each human life lost by typhoid fever. An investigation of this subject begun by the writer many years ago, but laid aside in the press of every day practice, showed that in an industrial city not far from New York, the average earnings of about 40 per cent of the population engaged in gainful occupation, amounted to $573 yearly, while the total earnings of the entire population amounted to $234 yearly per capita. The latter earnings continued twenty-five years, have a present worth, at 5 per cent of $3297 while the earnings of the workers would be worth $8073. In this particular case the average value of a human life in that city would not be represented by the smaller amount, because many not classed as gainfully occupied, such as the housewives and mothers of families, are worth the larger sum. The author's table 11 must also be taken into account, it shows that 75 per cent of the deaths from typhoid are of persons between the ages of 10 and 49, thus including a large proportion of the wage earners. His adopted value is certainly not too large.

He points out what has always seemed to the writer very important, namely, the additional deaths caused by a depleted vitality

among those who recover from typhoid. This means that the actual effect on the total death rate is much greater than that due to the typhoid deaths alone. An attempt to suggest this was included in the unfinished paper already referred to. The reduction in typhoid in the city of Newark, New Jersey, due to the introduction of a pure water supply in 1892, was accompanied by a still greater reduction in the total death rate, which from 1886 to 1892 averaged 25.87; and from 1893 to 1899, 20.76; whereas during the same periods, in all other cities in New Jersey the figures were 22.05 and 19.62 respectively. That is, there was a reduction of 5.11 per 1000 in Newark, as against 2.43 in all other cities of the state. Assuming that the additional saving of 2.68 per 1000 in Newark was due to the introduction of pure water, it represented 485 lives saved yearly; whereas the reduction in typhoid deaths alone was only 60 yearly. On the same basis of comparison Jersey City showed a reduction in total death rate of 3.22 per 1000, greater than the whole state, representing 664 lives saved, of which only 109 were accounted for by the typhoid rate alone, and in Paterson a reduction of 1.76 per 1000 greater, representing 184 lives of which 21 represented the saving in deaths from typhoid. Even if not proven, surely these instances suggest that the total saving of life due to the introduction of pure water may be six or seven times that which is represented by the typhoid death rate alone. It is noticeable that those cities which have a low typhoid death rate almost invariably have a total death rate lower by a much greater amount than the difference in typhoid deaths. This may be due partly to the lowered vitality noted by Mr. Johnson and partly to the effect of diarrheal and other diseases chargeable to polluted water, but not so easily traced as typhoid.

Up to April, 1892, the city of Newark took its supply from the Passaic River at Belleville. It then introduced a pure supply from the Pequannock River, collected from a drainage basin, which had a scattered population of about 40 to the square mile, 80 per cent of the area being woodland. It was practically free from sewage pollution and has been maintained in good condition by large purchases of land and the removal of dwellings. For five years previous to the introduction of this supply, the deaths from typhoid had averaged 108 yearly. The average for five years after was 48 yearly. It is interesting to note that from November to June, the average number of deaths before was 76 and after 22, a reduction of 71 per cent, while from July to October, the average was 35 before and 22

after, a reduction of only 37 per cent. During the vacation months much of the typhoid was caused by drinking water from other sources than the public water supply, while no doubt, flies, oysters and uncooked vegetables also had their effect. Unquestionably, the public water supply was chargeable with a less percentage of the total number of deaths from typhoid from July to October than during the remainder of the year.

In spite of the prevalence of typhoid in both Jersey City and Newark, while they were using sewage laden water from Belleville, the writer noticed evidences of a very considerable degree of immunity. Had it not been for this, undoubtedly typhoid would have been epidemic in these communities to a much greater degree than actually obtained. There were some evidences that this immunity was lost after the introduction of pure water. In March and April, 1899, after the new supply had been in use seven years, owing to a shortage in the Pequannock supply, some water was turned into the mains from the old supply at Belleville. Immediately typhoid developed, and the number of deaths during the two months ran up to 42, whereas before the new supply had been introduced, when Belleville water was used exclusively, the average for the two months had been 13 and the maximum 25.

Jersey City used a supply from Belleville until 1896, when it introduced water from the Pequannock; not a full supply, however, until the beginning of 1897. During the five years preceding, the average typhoid rate per 100,000 population was 74, and during the five years following, it was 21. These figures may be compared with 69 before, and 23 after for Newark.

It would seem that there is still more to learn as to the full effect of a change to pure water, because the reduction in typhoid appears to continue for some years after. Even if this is aided by the introduction of other sanitary measures, it will be conceded that such measures are more likely to be introduced, and their importance is more likely to be realized, after the one principal cause, namely, a polluted water supply, has been removed. There is not, as yet sufficient experience as to this after effect, but the following figures are suggestive:

	BEFORE	AFTER	1910–13	DATE OF CHANGE
Newark	69	23	9	1892
Lawrence	110	23	13	1893
Jersey City	74	21	10	1896
Albany	109	28	19	1899
Paterson	29	9	8	1904
Washington	55	31	24	1907
Pittsburgh	132	19	12	1908

While all of the foregoing illustrations are not cases of filtration, they are, nevertheless, pertinent. It is noticeable that for the first five years after the introduction of pure water, the above cities show an average rate of 22 typhoid deaths for 100,000 population, whereas the average for those in which the change occurred not later than 1904, had fallen to 12 in the period 1910-1913.

As a reminder of things still to be learned, the writer had in mind three communities of from 12,000 to 40,000 population, all of well to do and intelligent people, in none of which is there any reason to suspect the water, and yet during the period from 1908 to 1912, the typhoid death rate per 100,000 was in A, 32, in B 23, and in C 7, while the total death rate per 1000 was in A 22.4, in B 14.1, and in C 9.2. In two other communities of similar population, mainly industrial, with many workers of rather low order of intelligence and a safe water supply, typhoid rates were in D 17, and in E, 19; and the total death rate D 17.8, and E 14.0. A is the wealthiest of all, intelligent and the least crowded, while E is the worst housed, the poorest, and least intelligent. Perhaps its people have a higher power of resistance to disease.

In most of the cities of the United States, improvements can only be achieved through filtration, but it is interesting to note that in the case of the Pequannock supply to Newark, it has been attained by removing the sources of pollution on the catchment, while Jersey City, with some pollution and ample sedimentation, appears to have accomplished fairly good results thus far by the use of hypochlorite or chlorine, without having inspired confidence, however, that actual cleansing of the water by filtration will not ultimately be necessary. Boston, also, has accomplished a progressive reduction from 48 to 8 by other measures than filtration, while New York has reduced its typhoid rate from 27 to 10 by similar measures. The results achieved in these four cities, without filtration, when

compared with those had by filtering such badly polluted sources as at Albany and Philadelphia, indicate that we should first acquire the best source of supply within reach, then filter when it becomes necessary. Clearly filtration will be all sufficient when we abandon the discharge of raw sewage into our streams and lakes.

Mr. Louis L. Tribus[23] (by letter): To the man who gives time to gather and classify statistics on any subject and cleverly weaves them together into a comprehensive and understandable whole, are due the thanks of his associates. The author has presented a paper which should convince the skeptical municipal official and impress the taxpaying public. Dollars and cents are the most potent factors in public welfare in the last analysis, but "sentiment" controls until the hard facts of a money pinch make themselves felt. The reality of the value of human life and effort to the community, from a monetary standard, is not often honestly considered. The factory measures human effort on a standardized machine basis, though occasionally some enlightened corporation looks further and measures operatives' work on a humanitarian basis as well as in light of current output.

Typhoid is the disease that comes most to the attention of the average engineer because of his sanitary work, but tuberculosis may also well require thought in his city planning and pavement questions. Disease creates expense; dust contributes to disease; cleanliness lessens dust; good pavements call for cleanliness; pavements cost money; therefore expense due to disease vs. expense due to pavements is quite analagous to net value of filter plants for safe water; sewage disposal works to save streams; garbage treatment systems to prevent flies and other nuisances. Proper housing, playgrounds, cultivation of the esthetic, make for happiness, happiness for good work, good work for financial and economic betterment, dollars saved and dollars made.

The problem is always an interesting one as to how far one community, whose natural outlet for drainage is a fresh water stream, should be obliged to purify its sewage; and how far the community further down stream should be obliged to purify its drinking water. They both have natural rights to the use of the stream. As a moral question it probably is incumbent upon the upper party to refrain

[23] Consulting Engineer, New York City.

from seriously injuring the quality of the water which is to be used by those further down stream. There is no question that it is incumbent on both to take steps to prevent all prevalence of typhoid fever, or other avoidable diseases.

The author has very wisely called attention to the fact that practically every sewage disposal plant is likely to fail in its work on some occasion, with the result that untreated, or half treated sewage finds its way into a stream. Under such conditions it is imperative that water supplies, if taken from the same stream, should be protected by appropriate forms of water treatment. These conditions are in general more important where sewage passes into fresh water, but in particular instances they have applicability where it is debouched into tidal waters. In such instances, aside from the question of nuisance to sight and smell, the relationship of fish and shell fish industries must be considered. Where such an enormous total of sewage as flows into the harbor of New York and its estuaries is under consideration, the expense of sewage purification work, as against the total value of the fish and shell fish industry is so overwhelmingly greater, as to make the industry practically negligible. New York and vicinity could very readily forego all fish food if such could only be derived from its own waters, rather than meet the expense necessary to purify its sewage so as to safeguard its fish, oysters and clams. Not so, however, with Chesapeake Bay and its estuaries, for the shell fish industry is there of practically international importance, consequently very large expense for sewage treatment is perfectly justifiable.

Though one may even estimate a financial value for human life and human service, which as a business proposition can be compared with the cost of decreasing a disease, there is no moral right to weigh one against the other; it is not amelioration, but absolute prevention that propriety demands.

Such figures as the author has presented are appalling and should carry great weight when studied and understood by those in responsible charge in our cities. Even so vast in importance as is the subject, it will only be given due weight when public sentiment is aroused; sentiment causes the expenditure of probably more money than any other cause, and often it is spent without much logic or real financial advantage.

The pictures which have been spread broad cast in the last few years, of flies proceeding from unpleasant materials to the bottle

containing the baby's milk, thus arousing sentiment, have done more towards abating the fly nuisance than all the statistics which demonstrated to a nicety that the fly is dangerous to human life.

The writer heartily advocates the compilation of statistics and the working out of figures to demonstrate the financial value of municipal improvements and heartily approves of their promulgation and their continual presentation for public enlightenment, but that intangible something, community sentiment, must be aroused before tangible results can be secured. The more of such papers the better.

PROF. IRVING FISHER[24] (by letter): Mr. Johnson's paper, "The Typhoid Toll", the writer considers a splendid presentation of the typhoid problem, and hopes it will receive the widest publicity possible. It is doubtless the most complete statement ever made of the typhoid situation, and the most convincing presentation of the criminal negligence through which typhoid is still allowed to exist. If these facts could be presented to the general public in the telling form in which Mr. Johnson has given them, the effect would be a wonderful improvement.

DR. WILLIAM A. EVANS[25] (by letter): We are grateful to Mr. Johnson for gathering this mass of information relative to the amount of typhoid fever, its cost in money and lives, and the success of the efforts which are being made to control it.

A few years ago there were several cities which were typhoid pest holes. They fed typhoid to other cities as well as to the rural districts. Practically all of these old-time city pest holes have purified their water supplies and are now no longer typhoid foci.

As the essayist says, it is now the rural districts which feed typhoid to the cities. The writer does not agree with the author that the rural citizen is essentially different from the city citizen. When the city man is depended on individually to control typhoid by boiling the water, preventing flies and pasteurizing the milk he falls down, just as does the country man. The reason for the greater security of the city man is because the government assumes charge of the water and in some degree, though lesser, controls fly breeding, supervises the milk, hospitalizes the cases and sends community nurses into the homes. In a few years the government, employ-

[24] Department of Political Economy, Yale University.

[25] Health Department, *The Chicago Tribune*, Chicago, Illinois.

ing different methods, however, will be rendering the same service to the countryman, whereupon the country will cease to feed typhoid to the cities.

Perhaps the writer does not agree with the conclusions expressed on page 272. The statements of fact are correct. The disagreement is as to the remedy. When the proposals for a water purification plant are being considered the amount of money involved and the inconveniences of the installation period are such that probably the communities will want the advice of experts in addition to guarantees. The better proposal is that in every health department there should be some one in authority with technical training and experience in sanitary engineering and particularly in water engineering.

The writer has been particularly impressed with the chart on page 281 showing the very much higher typhoid summer peak in the country as compared with the city. The explanations of this high peak given by Mr. Johnson state the facts.

As to the table 11 on page 284 we are liable to get an exaggerated idea of the immunity of people past 40 from this table. It is hoped Mr. Johnson will prepare another table showing the age distribution of the people in the registration area. Such a table would show, for instance, that one reason why the typhoid deaths among people 50 to 59 years of age is only 6.6 per cent of the total is because the population with ages between 50 and 59 is not large. Of course, the heavy incidence of typhoid is in persons in the groups with ages from 10 to 19 and 20 to 29 years, but the difference between the incidence of those groups and the incidence of 50 to 59 years, for instance, is not so great as the figures indicate.

Many ordinances and rules now make a distinction between the restrictions placed upon a house where a trained nurse is caring for the typhoid patient, and one where members of the family act as nurse. Reading pages 290–291 the thought comes into the writer's mind that we will not be able to prevent contact infections, or "finger" infection, until we either require that all typhoid be hospitalized, or else that that which is not hospitalized shall be cared for in the home by trained nurses, community nurses or private nurses.

Dr. Levy of Richmond has had just as striking proof of the relation of flies and privies as that cited from Dr. Terry of Jacksonville on page 299.

Mr. Johnson is right in his opinion that water purification will reduce the typhoid rate more than Dr. Freeman states. Probably a materially greater reduction can be expected than Mr. Johnson claims. When the water borne typhoid is eliminated, in addition to the reduction in direct water-caused cases, there is a reduction in the indirect or secondary cases. These should be added to the expected reductions in typhoid as a result of water purification.

As to table 20 in the Appendix, the JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION for April 22, 1916, furnishes the typhoid data for American cities for 1914 and 1915.

The article by Mr. Johnson makes no extravagant claims. In fact if it errs at all it errs on the side of conservatism.

PROF. C.-E. A. WINSLOW[26] (by letter): Nearly fourteen years ago at the New Orleans meeting of the American Public Health Association, December, 1902, Prof. W. T. Sedgwick and the writer presented a paper "On the Relative Importance of Public Water Supplies and Other Factors in the Causation of Typhoid Fever", with the following conclusion.

> We have undertaken to show:
>
> First. That in the State of Massachusetts and in some of the larger cities of the United States the public water supplies are now unimportant as vehicles of typhoid fever.
>
> Second. That in cities having pure water supplies the annual curve of typhoid fever mortality closely follows that of annual temperature.
>
> Third. That in urban communities supplied with pure water there still remains a typhoid fever tax of from 15 to 25 deaths per 100,000 population.
>
> Fourth. That this tax is due not to any peculiar condition of soil, locality or climate, endemic factors, but to incomplete disinfection of typhoid excreta with subsequent infection of various articles of food and drink. These factors, when acting upon a few or many persons at one time, may cause obvious epidemics, sometimes large, though generally small; but more often the infection in moving from one point to another follows different and obscure routes for different victims, and hence may be described as *prosodemic*.
>
> Fifth. That the only remedies for such prosodemic typhoid are absolutely thorough and universal cleanliness and disinfection of excreta.

Reference is made to this paper because the authors were probably the first observers in this country to call attention to the importance of non-water borne prosodemic typhoid and to the significance of the seasonal curve of the disease in determining whether

[26] Prof. of Public Health, Yale University.

in a given community typhoid fever is or is not primarily a water borne disease; and also because the conclusion that a death rate of 15 to 25 per 100,000 was a normal death rate is interesting in the light of recent progress.

The following comparison of the typhoid death rates in large American cities in 1903 and 1913 from Table 20 in Mr. Johnson's paper brings out in a striking way the progress that has been made in the last ten years.

Typhoid death rates in large American cities in 1903 and 1913. Number of cities in each class. Typhoid death rate per 100,000.*

	10 AND UNDER	11–20	21–30	31–40	41 AND OVER
1903	2	19	13	12	28
1913	21	33	15	3	5

* The numbers in the two lines do not check, because data were not available for four of the cities, Birmingham, Des Moines, Los Angeles, and Wilkesbarre in 1903; while in 1913 Allegheny had been made a part of Pittsburgh.

Wonderful progress has been made during the past decade but we are still a long way from the standard of the best European cities, where typhoid death rates under 5 are by no means rare. The preparation of Mr. Johnson's admirable and exhaustive study is therefore an event of unusual importance, and should establish a landmark in the development of American sanitation.

The securing of pure water supplies placed within the reach of every community by the development of the process of chlorine disinfection, and pasteurization of milk supplies, which should be made a universal practice, have almost done away in progressive communities with widespread epidemics of typhoid fever. The prosodemic spread of the disease, however, by diverse and mysterious individual pathways, remains a serious problem. "Food, fingers, and flies," to resort to the expressive phrase which has been used so much in popular health literature, are the principal vehicles of this disease, and in the individual case they are exceedingly difficult to control. The only point that the writer finds to criticise in Mr. Johnson's suggestive comment on the fine array of statistics which he has collected is his statement that the susceptibility to typhoid is just as great in a person who bathes every day as in those of less cleanly habits. If bathing is correlated, as it undoubtedly is, with

general social conditions, the truth of this is doubtful. In a recent study of typhoid statistics in New Haven, for example, the writer has been greatly impressed with the fact that the high rates are invariably associated with congestion of population and with poverty, following very closely the distribution of the high death rates from tuberculosis and infant mortality.

Municipal cleanness, particularly those phases of it which relate to the disposal of human excrement and the breeding of flies, and personal cleanness, particularly in regard to the preparation of food, seem to be the remedies, and these involve a slow and persistent process of public education in which the schools must play an increasingly important part.

Meanwhile mention should certainly be made of one important weapon, namely, that of anti-typhoid vaccination. The brilliant results obtained by the use of this procedure in the United States Army, and the less complete but significantly successful results obtained in Europe during the great war, make it clear that the use of typhoid vaccine ought to be stimulated by every possible means. In particular no one who is especially exposed, as are nurses and doctors and persons who travel a good deal, such as engineers for example, should neglect this simple and generally effective measure of protection.

Mr. J. W. Ellms[27] (by letter): The forceful manner in which the subject matter of this paper is presented should have the effect of breaking down the indifference of the public to matters of health, and of educating officials responsible for initiating sanitary reforms. That "money saved is money earned" is an axiom that apparently finds small favor with the American public; and only by the slow process of education can the truth of this saying be driven home in its application to abolishing insanitary conditions.

The remarkable reduction in typhoid fever almost always effected when a polluted public water supply is purified has served to emphasize this source of infection to the exclusion of other sources. Even after the purification of a water supply has successfully demonstrated a marked reduction in the prevalence of water borne diseases, the residual cases are sometimes looked upon with suspicion as possibly due to the imperfections of the methods of purification adopted. In some cases this may be true. Only by the most

[27] Superintendent, Filtration Plant, Cincinnati, Ohio.

careful supervision can the quality of the purified water supply be maintained, and the reason for suspicion allayed. Even among sanitarians there appears to be a willingness to allow the purified water supply to be held responsible for all water borne diseases not traceable to other sources. This is largely due to the bad reputation which the water supply acquired prior to its purification, and is perhaps quite natural.

The point which the writer desires to emphasize, however, is that in any properly conducted sanitary survey the sources of infection should be as carefully traced as possible, and to each source should be charged only the cases and deaths that the evidence obtained will substantiate. The complexity of such a survey is fully appreciated, but after all does not its value depend upon the reliability and positiveness with which the true sources of infection are ferreted out?

This matter has a practical bearing, in that intestinal diseases traced to dirty milk, unclean vegetables, contaminated shell fish, unscreened out houses, etc., may be made the subject of sanitary regulations, and these regulations enforced at comparatively small cost to the community. On the other hand, the elimination of pollution in a public water supply is a community matter that requires the expenditure of considerable sums of money. Epidemiological studies, therefore, should indicate as definitely as possible to what extent the public water supply is responsible for water borne diseases.

These sanitary surveys should be systematically carried on in every community, and the information obtained should be published and made the basis for pushing forward sanitary reforms intelligently. In this way the public will become educated to see its own needs, and will be far readier to furnish the funds to remedy unhealthful conditions.

Mr. W. H. Dittoe[28] (by letter): As a factor in reducing the prevalence of typhoid fever, and deaths resulting from this disease, the development of water purification in Ohio must be given an important place. The first purification plant for a municipal water supply in the state was installed in 1895. Since that time the development has been active, and on January 1, 1916, there were thirty-five water purification plants serving forty-eight communities,

[28] Chief Engineer State Board of Health, Columbus, Ohio.

with a total population of approximately 1,340,000. During the present year seven new plants will be completed and placed in operation, and with these, seventy-one municipalities with a total population of 2,200,000 will be served with filtered water. At the end of the present year the following conditions, as regards public water supplies in Ohio, will obtain.

CLASS OF SUPPLY	POPULATION OF MUNICIPALITIES SERVED	TOTAL POPULATION SERVED BY PUBLIC WATER SUPPLIES	TOTAL POPULATION OF STATE
		per cent	*per cent*
Surface water—filtered	2,205,000	64.6	41.6
Surface water—disinfected only	89,000	2.6	1.7
Surface water—untreated	97,000	2.8	1.8
Mixed supplies (untreated surface water and ground water)	16,000	0.5	0.3
Ground water	1,008,000	29.5	19.0
Total	3,415,000	100.0	64.4

The population not accessible to public water supplies is 1,881,-000, representing 35.6 per cent of the total population of the state. This population is made up of 252,000 residing in 458 small villages, and 1,629,000 which is truly rural. Of the 458 communities not provided with public water supplies only three have populations exceeding 2500, and forty have populations of 1000 or more. In these communities marked reduction of typhoid fever may be brought about by the installation of public water supplies of good quality.

In view of the fact that before the end of the present year 87 per cent of the population of the state, residing in incorporated communities, will have access to public water supplies which are filtered or obtained from ground sources, it is apparent that much has been accomplished to safeguard the state as a whole from the danger of typhoid fever due to polluted public water supplies.

Dr. Frank G. Boudreau[29] (by letter): There is great need for the public presentation of the problem of typhoid fever prevention in a clear and concise way. The study Mr. Johnson has made for

[29] Director Division of Communicable Diseases of the Ohio State Board of Health.

the country as a whole, state officials should make for the individual states and city officials for municipalities. In other words, close study of the prevention of this filthborne disease is needed. Unfortunately, as Mr. Johnson has pointed out, facts upon which to base such a study are lacking. In Ohio a record of typhoid fever and other deaths was begun about 1870, but accuracy was not approached until 1909, when the state was admitted into the United States registration area for deaths. In 1882, incomplete records show that more than 2000 deaths occurred. In 1915 only 718 deaths occurred. Had the rate which obtained in 1882 held until the present time, more than 3500 deaths would have occurred in Ohio in 1915. A major part of the responsibility for the reduction of typhoid fever must be credited as Mr. Johnson has so clearly shown, to the purification of surface water supplies. In Ohio in the early nineties typhoid fever death rate curves for the cities rose higher and higher as sewage pollution of the streams utilized for water supplies increased. This tendency for increasing typhoid fever death rates was in some cases arrested temporarily by the removal of intakes from nearby pollution. The best example of this occurred in Cleveland. In 1903 a widespread and clearly water borne typhoid fever epidemic occurred during January, February and March. In 1904, the intake crib was removed to a point four miles directly north of the Cuyahoga River, a sewage-laden stream. Following this the typhoid fever death rate has never risen above 20 per 100,000 living persons. However, careful studies showed that water borne typhoid fever was still occurring in Cleveland, and in 1911 disinfection of the water supply with calcium hypochlorite was resorted to. In 1916 rapid sand filtration with disinfection as an auxiliary measure will replace the present system.

In eleven cities and three villages of Ohio with an aggregate population of nearly a million, filtration of public water supplies reduced the number of typhoid fever deaths over 62 per cent. The reduction was roughly from an average rate of 60 for the five years before filtration to an average of 20 per 100,000 for the five years following the installation of filters. Dozens of Ohio cities and villages were not included in this compilation either because reliable data as to typhoid fever deaths were not available, or because filters were installed too recently to allow a five years study of their results. Among the eleven cities and villages included in the compilation were some which experience little benefit from filtration as far as typhoid

fever is concerned. Toledo is the best example. In that city a water having undesirable physical characteristics was used prior to filtration. The citizens did not become accustomed to the use of this water, but used well water for drinking purposes, as ground water is abundant and easily secured. A recent census of seventy representative city blocks formed the basis of an estimate that there are 10,000 private wells in Toledo. In addition, the gross prevalence of typhoid fever for a number of years in one ward of that city was shown to be due to the milk supply. A typhoid fever carrier was found at one of the dairies.

Filtration of the public water supply was most effective in Cincinnati, so far as typhoid fever is concerned. The typhoid fever death rate fell below twenty immediately, and has fallen below ten during the last four years. Further, the monthly distribution of typhoid fever deaths obtaining prior to filtration was completely reversed following the installation of filters, and the seasonal distribution of typhoid fever in Cincinnati is now similar to that found in cities with pure water supplies.

In Youngstown, filtration of the public water supply was followed by an immediate reduction in the typhoid fever death rate, but the number of such deaths continued high. Hansen studied the situation in 1906 and found that a large majority of the cases were in houses connected neither with the public water supply nor with sewers.

The reduction of residual typhoid fever has not been so successful in Ohio as the reduction of the water borne variety. Cincinnati has been perhaps most successful. In Cleveland, water borne typhoid fever perhaps still exists, but that due to other sources has been appreciably reduced. Probably the lack of success in reducing residual typhoid fever has been due in part to lack of proper supervision of milk supplies. Of the twenty largest cities in the state, Steubenville and Ashtabula are the only ones not supervising the milk supplies. Youngstown was the first city to practice supervision, June 1902. Portsmouth and Lima did not begin inspection until 1913. Health officials of nine cities state that supervision of the milk supply is now efficient. Fourteen cities report that all dairies are regularly inspected. Bacterial counts are made by health departments of fourteen cities, and thirteen cities require bacterial standards varying from 100,000 to 1,000,000 bacteria per cubic centimeter. Eight cities report that dairy supervision has had a good effect in preventing typhoid fever. Six cities publish the results of

dairy inspection and milk analysis. In thirteen cities typhoid fever cases are checked against the dairyman supplying the milk. To summarize briefly, in not more than five of the twenty largest cities of Ohio does supervision of the milk supplies approach the ideal. In half of the cities some of the simplest precautions that are effective in preventing milk borne typhoid fever are neglected. Only three cities require pasteurization.

Since 1886, when the Ohio State Board of Health was established, 102 typhoid fever outbreaks have been investigated by representatives of the board. Fairly complete reports of fifty-seven outbreaks are on record. Of these, twenty-four were water borne, nineteen milk borne, eleven were due to contact, and three to food. Sixteen of the twenty-four water borne outbreaks were traceable to public water supplies. Three of these were due to faulty operation of filters, three to the introduction of raw, polluted water into the public supply by means of industrial connections, and the use of emergency intakes was responsible for seven. Of the nineteen milk borne outbreaks, typhoid fever cases or carriers were found at the dairies in eleven instances. Oysters were responsible for one outbreak of paratyphoid fever.

The prevention of typhoid fever has been thoroughly discussed by Mr. Johnson. Emphasis should be laid upon his statements in regard to the inexcusable loss from water borne typhoid fever, and the necessity for state supervision of filter plants when once installed. Supervision of milk supplies is still in its infancy and must be extended and intensified. The prevention of sewage pollution of streams should not be delayed until the danger point has been passed. Public health education and close study of all cases are requisites too often neglected in the prevention of typhoid fever. Using the most conservative figures, typhoid fever causes an average annual loss of $4,350,000 in Ohio. According to Mr. Johnson's estimates, the annual capital loss from typhoid fever in Ohio averages $7,900,000. The judicious expenditure of a small proportion of this sum every year in Ohio would pay dividends entirely out of proportion to the sum expended.

Mr. C. A. Emerson, Jr.[30] (by letter): The author has collected and correlated a mass of facts and figures that should bring home to

[30] Acting Chief Engineer, State Department of Health of Pennsylvania.

all the truth that funds invested in health insurance return handsome dividends.

Emphasis is placed upon the value of water purification as a factor in the reduction of typhoid fever. This is a rational position, for the public water supply is the only commodity that is ordinarily used in common by an entire community. The results of its infection by the typhoid organism will therefore be greater than a similar pollution of milk, uncooked vegetables, fruits, oysters or other food stuffs pointed out as occasional paths of transmission, but which are used only to a limited extent, and in the average community are obtained from many sources, which fortunately for the most part are free from contamination. A study of many recorded epidemics occurring in scattered communities throughout the country indicates that practically without exception every one which included a great number of cases was due to a polluted municipal water supply.

The public at large now generally realizes the danger of grossly and visibly polluted drinking water, and fortunately a large proportion of such supplies, either through the exercise of law or the weight of popular sentiment, has been properly protected or purified.

The next step is to safeguard the public health in communities where the water supplies are obtained from sources which are generally considered to be above suspicion. Many cities repose in fancied security because the source of the water supply is described as a "pure mountain stream", rising perhaps in some state or federal forest reserve or in a section of country containing only a few scattered habitations and rarely traveled public roads above the point where the stream is turned into the head of the supply line. As our knowledge increases we are awakened to a realization of the dangerous possibilities of such supplies. A single hunter, fisherman, berry picker, or chance traveler passing over the watershed, or the occupant of an isolated farmstead, a forest ranger's cabin or a temporary camp, if he happens to be in the incubation stage of typhoid fever or a convalescent from the disease may by careless disposal of excrement be the cause of a widespread epidemic sweeping through the entire community and resulting in many deaths. Large epidemics have been recorded due to such remote causes as the discharge of typhoid infected sewage into a stream from the toilet on a passenger train passing over the watershed from which a public supply was drawn.

Careful and conscientious patrols of watersheds at frequent intervals, the installation of proper sanitary conveniences at all occupied habitations, the posting of prominent notices warning the public against causing a contamination of the stream and the closing of toilet rooms while the trains or trolley cars are passing over the watershed have a certain value in safeguarding the supply. Such measures, however, because of their manifest shortcomings, can only be viewed as temporary expedients to be followed at the earliest possible date by the installation of a positive and adequate method of purification of the water.

The statement has been made on several occasions that every public water supply taken from surface streams must be viewed with suspicion unless purified by filtration or by depopulation, patrol and protection of the watershed combined with purification of the water through natural agencies brought about by long time storage in properly designed reservoirs. At first thought this statement appears unreasonable, yet careful consideration of the many possible sources of contamination of the usual water supply derived from upland streams demonstrates that it represents a sound and justifiable view.

As pointed out by the author, the eradication of typhoid fever will require much more than the purification of the public and the protection of private sources of water supply. Every method of warfare known to sanitary science must be brought into action against the spread of the disease, such as treatment of municipal sewage and proper disposal of that from habitations in the rural districts, protection of milk and other food supplies and many other precautions including those of prime importance, the isolation and proper care of the patient, and the conscientious and thorough disinfection of excrement, bedding, dishes, etc.

This general work must of course be performed by the local, state and federal boards of health. Disease does not respect the political boundary lines placed on a map, and unless checked will spread as easily over a county or state boundary line as throughout a single community, providing of course, that the channels for its continuation are present. Coöperation of the various protective forces is therefore necessary.

The magnitude of this general work in the rural districts is not thoroughly recognized. The population in these districts forms a considerable percentage of that of the entire country. Take Penn-

sylvania as an example, over 2,600,000 people, or approximately one-third the total population of the state, reside in the townships, where there are no regularly organized local boards of health. This number represents something over five hundred thousand separate dwellings, most of them with individual water supplies and separate methods of sewage disposal in other words, one-half million possible avenues for the spread of water borne disease. The purification of a public water supply, the construction of a proper sewerage system and the installation of other general measures will place a protective barrier around the great number of residents in a city and may have an appreciable influence on the typhoid death rate for the entire state. To offer the same protection to an equal number of the rural population will necessitate the visiting of perhaps several thousand individual homes and the solution of as many separate problems in sanitation. The municipality has resources which can be made applicable to its problem beyond the means of the average dweller in the rural districts, and also the urban population have opportunity to derive the benefits of coöperative action. It therefore devolves upon some central controlling body, such as the state board of health, to awaken the countryside to its dangers and through friendly advice, and when necessary by the police power of the sovereign state to battle with the common foe. Pennsylvania found such procedure to be necessary and accordingly on the reorganization of the state department of health eleven years ago, provision was made for over 700 local health officers, who, under the direct control of the state, administered health affairs in the 1556 townships of the rural districts. This work has been carried on with great success.

The fight against typhoid fever is apparently a winning one, but to make the victory complete it will be necessary for every citizen of the country to realize his duty to his neighbor and his government, and to observe the health laws and regulations as well as those referring to criminal procedure or property rights.

Mr. W. F. Montfort[31] (by letter): Making people better than they wish to be is difficult. When the red light district is abolished the inmates move to freer quarters. When the saloon is closed the express companies provide.

[31] Consulting Chemist, St. Louis, Missouri

While there is nothing attractive or enticing about drinking impure water, using contaminated milk, and living in unsanitary conditions, these are not exhilarating nor pleasurable sins, the law of inertia holds for persons and communities; they continue in an habitual way unless acted upon by some outside force. Theoretically, perhaps, no one will endure a water or milk supply known to be impure; practically the source of an explosive outbreak of intestinal disease is brought to light only after the epidemic is well under way.

The data assembled by Mr. Johnson in his paper "The Typhoid Toll" in the June issue of the JOURNAL OF THE AMERICAN WATER WORKS ASSOCIATION, present a convincing argument for common-sense "preparedness" in sanitation. As usual, the people preached at are not in the audience. How to get a hearing with sinning communities before a crisis comes is an unsolved problem. Wisdom is not organized in the public behalf.

In the states of Arkansas, Illinois, Iowa, Kansas, Kentucky, Missouri and Oklahoma are 1280 water works of varying size; of the cities thus supplied 95 are represented by members in the American Water Works Association. That is, Mr. Johnson's data will directly reach 7.4 per cent of these cities, and the remaining 92.6 per cent (1185) will hear of it only by chance, if at all. While reference to his paper will appear in several engineering journals, this will probably not greatly increase the number of water works men who have access to the information; for the 78 pages of text and tables are too much for publication in full, and abbreviated statements will likely fail to convey the message adequately.

Yet typhoid fever costs the citizens of the United States about \$150,000,000 a year; for 300,000 persons suffer, and 20,000 die from it annually, and every case of typhoid fever is due to somebody's ignorance or neglect. "For lack of vision the people perish."

It would seem good business to buy immunity from preventable disease rather than pay tribute in lives of much greater value than the price of saving them. Two years since Dr. Hurty, President of the State Board of Health of Indiana, inveighed against the public policy of disregarding human beings exposed to as deadly plagues while protecting non-human livestock against tuberculosis, cholera and other plagues. In 1914 Congress appropriated \$500,000 for the prevention of hog cholera and refused a measly \$5000 for the child's welfare bureau. In our own good state of Indiana we had in the gen-

eral assembly a parallel to this strange performance. It provided that $25,000 should be expended for saving hogs, and $2500 for saving babies. And thus it was established that hogs are worth ten times as much as babies in Hoosierland. Why it was not made 16 to 1 was never explained. One might infer that in national, state, city and rural politics swine and other domestic animals had the suffrage rather than their owners.

Helping people to want better sanitation will be done in each community by some form of educational campaign. As part of such campaign a statement of an argument of which this is an abridgment has been sent to 450 men connected with water works in Missouri and adjoining states.

Mr. John C. Trautwine, Jr.[32]: Mr. Johnson has modestly called his paper "The Typhoid Toll". It might justly have been entitled "An Appreciation of the Principles of Human Government". We still suffer outrageously from typhoid, from flies, from dirt, from nuisances of all descriptions, perpetrated by the sovereign individual. On page 253 Mr. Johnson indicates the sufficient reason for this when he reminds us that the national government has no adequate control over the sanitary matters of the states, or the states over those of their cities, or the cities over those of their citizens.

All the medical and biological science in the world could not have transformed the Panama Canal Zone from a plague-spot into a health-resort, if it had not been that governmental science, backed by the strong arm of the 100,000,000 people of the United States, compelled the Zone people to do what was in their own interest.

The history of civilization is the history of the subordination of the individual to the community and of his coördination as a member of the community. It is the history of our progress from savagery toward that condition of paternalism which was deprecated by President Hill during the superintendential discussion over fire-connection rates, and of which public water supply is one of the most illuminating examples, a paternalism under which, to quote Mr. Hill, the community will do everything for everybody.

While we remain in the transition state between these two extremes—while we fall short of the inevitable and complete paternalism of the near future—we must remain content to devote morn-

[32] Civil Engineer, Philadelphia, Pennsylvania.

ings to the adjustment of inadjustable relations of meum et tuum, between insurance companies, municipalities, water companies, individual consumers, and all the other innumerable parties interested in the great game of grab; concentrating, like Bunyan's "Man with the Muck-rake", upon "the straws, the small sticks and dust of the floor", and neither looking up nor regarding, though one stand over us and proffer us a celestial crown.

Nations suffer from what they call their "victories", as well as from their defeats. Our worship of the "liberty" fetich, "the spirit of 1776," still blocks the way to freedom from worse oppressors by making us unwisely reluctant to entrust our health officials with those large powers and those large means, without which, in this day of intense specialization, they cannot serve us efficiently.

We are indeed willing to hire experts to teach ourselves and our children languages, living and dead, and dancing; to cure our bodies of disease and to purge our souls from sin; but we resent dictation from our own high-browed sanitary specialists, and permit them to be ham-strung by our ignorant representatives in the municipal legislature.

We are unwilling even to entrust our highly paid Executive Committee with so simple a matter as the selection of the place of holding the next annual convention. We prefer to spend a precious Convention hour or two in balloting and eloquence, after the local patriots of the rival cities have spent months in lining up their forces, and days in plastering the walls of the convention place with "scenery".

We have not yet learned to realize that the moneys we pay out in taxes yield us far greater returns than do any private investments, and we therefore imagine we are clever when we keep down the tax rate by starving the health man.

Thus far our fear of officialism has been justified by the persistence of a "business" system which puts its premiums upon self-seeking. The community is the easiest of all easy marks, for no man is interested in caring for its welfare, or realizes that he is so interested, and we naturally distrust those who have got into positions where they seem to have access to the public purse. Who wonders that Mr. Maury's conscientious reservoir contractors have gone out of business? The honest man gathers no moss. And yet, democracy is not necessarily inconsistent with the concentration of proper authority in expert hands. Imagine a democracy, intelligent enough

to recognize its own limitations, and virtuous enough to avow those limitations and to insist that its technical works shall be placed, *and left*, in the hands of well paid experts, untrammeled by popular ignorance and meanness. Such a democracy would be that best of all possible governments, a despotism under a good despot.

The Philadelphia city charter, granted nearly thirty years ago, recognizes the true principle, in that it places the city's public works "under the direction, control, and administration of the department of public works", and commands the city legislature to "provide for the proper and efficient conduct of the affairs of the city by the mayor and several departments, and the boards thereof". It also explicitly forbids their honorable bodies to "pass any ordinance directing or interfering with the exercise of the executive functions" of the mayor and his executive subordinates. The fact that these provisions have remained, and that they still remain, a dead letter, seems to throw doubt upon the gain accomplished when a community or its representatives are persuaded to adopt measures long before the people are educated up to such measures.

During a recent discussion, two interesting myths were mentioned. One of these was "the non-invasive individual", the individual who does no injury to society. The other was "our home as our castle". That there is no such animal as a non-invasive individual is only another way of putting what was written at least some twenty centuries ago, "No man liveth to himself alone." With every breath we draw, and with every thought we think, every one of us is every moment and inevitably invading the community. If our homes are indeed our castles, their walls are of a glass transparent to such invasion, which passes freely through them, both ways.

It would be rash to set bounds to that socializing process which forms the most notable feature of our modern life; but it may be interesting to glance at a short and nearby arc of its curve. A century ago, the supposedly non-invasive individual was left free to wreak pretty much what damage he pleased upon the community, and thus upon himself. Today, and quite without his realizing it, he has become subordinated to a despotic community control against which our patriotic forefathers would have rebelled as strenuously as they rebelled against George III. The city dictates to us the maximum heights of our buildings and the method of their construction. It even dares to suppress the God-given right of every redblooded American to expectorate upon the sidewalk. And yet we

have barely scratched the surface. Fifty years from now, our successors will stand aghast at the recital of the outrages which the individual of today is still permitted to perpetrate upon his fellows, and will refuse to believe that our horror of "tyranny" could keep us until 1916 before we could realize the duty of a city to restrict its different lines of "business" within prescribed "zones", as New York is now beginning to do. They will accept as matter of course social domination which to us of today would seem as outrageous and as ridiculous as interference with spitting would have seemed to George Washington.

Mr. Johnson's paper blazes the way of progress.

For better, for worse, our people are not Panamans. They would reject the suggestion that they should submit to their own control as they imposed it upon the Canal Zone; so they must be content to grow healthy more slowly. Sanitary engineers in the United States have not yet the powers of army officers. They must gradually acquire the needed power, by demonstrating, as opportunity offers, their worthiness of it. Happily, "the(m)asses" do eventually learn by experience. Take, for instance, the filter and the water meter. These are useful as illustrations of the process, and as entering wedges for its operation. Like Mr. Goodrich's underground fire-hydrants, and everything else new, they are of course unpopular where they are unknown; but where the engineer has succeeded in placing them, they are warmly appreciated, the engineer has grown in the public confidence, and the way is thus opened for his acquisition of control in other directions.

Inertia, which governs in social as well as in physical matters, forbids sudden and radical changes. We cannot all become rational beings by a somersault; but, in this quieter and less spectacular, if also less heroic, way we are creeping on toward the ideal government, a benevolent despotism.

Commenting upon harmful interference, by state boards, with designs for local works, and upon delays caused by the deliberateness of such boards in passing upon such plans, Mr. Johnson suggests that state boards be relieved of the duty of passing upon plans, and that their function be restricted to that of seeing that proper results are obtained. The writer leans to the view that the true remedy is rather the reverse of this, viz., to secure higher-class timber for the state boards, and to charge them, not merely with criticism, but with the creation of local designs; for our small com-

munities often have not the means to secure, even if they have the ability to select, the best engineering talent. Better still, let us hope for the day when state boards shall be no more, and when our engineers of the highest class shall be found coöperating in a national or even in an international board, charged with the design and construction of the works for all the water supply units of the nation or world, and of coördinating them into a national or a world water-supply system.

Dr. Peter H. Bryce[33] (by letter): Mr. Johnson's paper "The Typhoid Toll", which has brought together in convenient form for reference the main facts dealing with the enormous losses from this endemic disease both of life and of wealth, has been carefully read by the writer. A phase of it may very properly be still added to such figures, viz: the losses due to the diseases which are the sequelae of this intensely exhausting disease. Remembering how many cases of tuberculosis infection exist and remain quiescent during good health, yet which spring into activity during an exhausted physical condition due to many causes and to none more than to typhoid, the total typhoid toll could be very greatly enlarged. Fortunately we now know not only the cause, but also the chief means of preventing this disease, which ought to be as extinct as cholera is in Europe and America. The writer finds, however, in the various fields of scientific and social effort which his work brings him in touch with that there is great need everywhere, not only of refining our knowledge as to causes, but also for enormously increasing our appreciation of personal and municipal as well as governmental responsibility of the possibility and of the duty laid upon us of taking adequate steps to stamp out the diseases of this sort. Mr. Johnson's paper ought to serve very greatly to bring home to many persons their duties and responsibilities. Dr. Herman Biggs' maxim, "Public Health is purchasable. Within rational limitations a municipality can determine its own death rate," is constantly recalled.

Mr. Joseph Race[34] (by letter): The cost of the typhoid toll on this continent is necessarily based on the typhoid death rate and the case mortality, and in Table I various data are given which are based

[33] Chief Medical Health Officer, Province of Ontario, Canada.
[34] Bacteriologist Health Department, Ottawa, Ontario.

on 15 cases to each death, or a case fatality of 6.6 per cent. Although this figure may be somewhat lower than that usually accepted, it is even higher than the case fatality obtained in the Ottawa epidemic of 1912. As there are some unusual features in connection with this epidemic a few details might be of interest. The midsummer outbreak of 1912 followed a midwinter outbreak of over 1000 cases in 1911, population 90,000, and 1309 cases with 87 deaths were reported. The case mortality based on these records was 6.64 per cent, but when the city in the following year took the unusual course of voting $100,000 for the alleviation of suffering caused by these epidemics, further cases were reported, and after investigation 150 cases were added to the health department's records. This addition reduced the case mortality to 5.96 per cent. Even this figure is high compared with the average mortality in the two emergency hospitals of 5.02 per cent. The average duration of hospital treatment was 29 days.

In connection with Table 7, in the following table the percentage reduction in death rate for each month is calculated.

MONTH	TYPHOID RATE PER 100,000		PERCENTAGE REDUCTION	SIX MONTHS AVERAGE
	1910	1913		
December	16.6	11.9	21.7	
January	15.0	7.5	50.0	
February	14.8	7.7	48.0	
March	16.4	7.5	32.7	
April	12.8	7.2	43.1	
May	11.7	9.8	16.2	35.4
June	12.4	9.8	20.9	
July	13.9	13.4	+3.6	
August	22.5	17.4	22.7	
September	29.3	19.2	34.5	
October	25.2	22.1	12.3	
November	22.6	16.4	27.4	19.0

These results show that it is the winter typhoid that shows the marked reduction and especially the incidence occurring during the months when the water temperature is at a minimum. If this reduction is attributed to an increased supply of filtered water and to improved methods of purification, and if, as is usually the case, the B. coli content in the water supplies of these particular cities is lower

in winter than in summer, additional evidence is afforded of the difference in the ratio of B. typhosus to B. coli in various seasons. The viability of B. typhosus is well known to be higher in cold water than in warm and yet sanitarians are attempting to establish rigid B. coli standards which take no account of this and other important factors that govern the ratio of B. typhosus to B. coli.

Mr. George W. Fuller[35] (by letter): Mr. Johnson's paper is one of unusual interest and importance and it will doubtless be referred to frequently for some years to come. The main lessons pointed out by it are well founded and not subject to material criticism. Nevertheless, his paper will produce different impressions on various readers, depending upon their personal viewpoint and experience.

Bearing in mind that it is scarcely thirty years since the germ theory of disease reached general recognition, even among the medical profession, and that modern water filtration plants have been in vogue for scarcely half that period, perhaps the most impressive item set forth by Mr. Johnson is the substantial accomplishment of municipal water purification plants in reducing the typhoid toll. As municipal affairs shape themselves, by and large, in this country, it is perhaps not so much a wonder that typhoid fever still prevails to the needless extent that it now does, as is the fact that it has been reduced as greatly as has been the case through various agencies, principally that of modern water purification plants.

As to the circumstances which have been associated with the installation of water filtration plants, it is certainly fitting to speak a word of commendation for the sound, far-seeing judgment of those who have dominated the policy of privately owned water plants whose accomplishments in the purification field, particularly in the early days, was most praiseworthy.

Mr. Johnson very properly deals in his paper with corrective steps yet to be taken to effect further reduction in the typhoid toll. Water purification is a very important factor, but it is not the only one. So far as relates to public water supplies of conspicuously unsatisfactory quality, perhaps the bulk of the population now getting such water are residents[35] of cities of small or moderate size.

How to bring about needed sanitary improvements in the public water supplies of small or moderate-sized towns and cities, partic-

[35] Consulting Engineer, New York, N. Y.

ularly those municipally owned, and how to promote this proposition so that it will occupy an advantageous relationship to various other demands upon the public purse, is certainly a pertinent theme for discussion.

Those in responsible charge of water works plants are not so much in need of education upon this point as is the public in the communities in question. Education of the general public, and in this way the control of public opinion, is probably the factor which needs most earnest attention in the reduction of the typhoid toll.

This question needs consideration from a broad viewpoint. The water works official who declares year after year the need of betterments to improve the quality of the water supply soon finds that he is telling an old story, and to engage public attention is in urgent need of new ideas in which to dress plain vital truths.

There are some who have suggested that the water works people have a narrow viewpoint and are not disposed to investigate public health questions on broad lines and to prepare themselves for discussing to a logical conclusion the relative merits of different steps involving public expenditures.

Broadly stated, there is need of discussion in the interests of the public health of the procedure which for a given investment will produce the greatest public benefit. To say that a water supply of unsatisfactory quality must be improved does not get the project very far at the present day. These questions should be looked upon in a rational and comparative sense, and the water works men should not be backwards in taking their place with adequate equipment in the field of molding public opinion.

For the water works men to say that it is not important to have district nurses and visiting housekeepers to teach public and private hygiene in households where such information is not acquired by custom, books, pamphlets, or papers, is idle talk. Water works men ought to join actively in public welfare movements and be prepared to see that water supply matters, as related to typhoid and other diseases, are kept on a proper basis, but not to the exclusion of other channels through which human life is subjected to sickness and death. In that way public water supplies are likely to be placed with a minimum of delay on a basis of proper relationship to the still further reduction which is needed in the typhoid toll.

If this comprehensive paper, with its statistical citations of facts and moderate interpretations, serves no other purpose than to stim-

ulate water works men into acquiring a broader, firmer and more effective viewpoint in the treatment of public welfare questions, the author may feel more than repaid for his task in writing this paper.

Mr. George A. Johnson (closing discussion): The author has been immensely gratified by the hearty interest displayed in the subject matter of his paper, and wishes to extend his sincere thanks to those who contributed to the discussion.

It seems to be the consensus of opinion that education, and still more education, is what is needed most of all, for, as Mr. Hering well says, "an ignorant citizen by a single foolish act can do more mischief than many officers may be able speedily to remedy". The efforts which are being made in this direction by the United States government, directed particularly at the education of the rural classes, are succinctly described by Dr. Blue. The viewpoint of philanthropic organizations such as the Russell Sage Foundation, is well expressed by Mr. Schneider.

Professor Monfort has poignantly said "For lack of vision the people perish". What truer words could be said of the typhoid situation in America today? As Omar remarked, "Heaven is but the vision of fulfilled desire"; so education is the promise which will bring fulfillment in better health conditions.

The insensibility of the public, reflected in the acts of the legislative bodies of our country, was never better demonstrated than in the action of Congress in 1914, when an appropriation of $5000 for the child's welfare bureau was refused, and one for $500,000 for hog cholera prevention was granted. Dr. Hurty, president of the state board of health of Indiana, pointed out a dismal parallel to this in the provision by the general assembly of that state of $25,000 for hog cholera and $2500 for the conservation of the health of children. Dr. Hurty then said: "Thus it was established that hogs are worth ten times as much as babies in Hoosierland".

Mr. Vogelson says that "Dividends must not be obtained by any risk of safety", and yet, as Mr. Ellms remarks, the axiom 'Money saved is money earned" apparently finds small favor with the American public. In this enlightened era the people of the United States, through "lack of vision", submit to an economic loss from typhoid fever many times in excess of the cost of preventing it.

It is not that we do not know how to prevent it. Dr. Freeman has said: "Our methods are certain, and will yield the desired result

in every case where they are properly applied. The problem is no longer investigative or scientific, but a problem of administration. The solution of the problem is how to convince the American people that protection from typhoid fever is something worth spending money for".

The author is in hearty accord with the views expressed in the discussion relative to educational campaigns. Men of international repute such as Dr. Wiley and Dr. Evans are especially well qualified by ability and position to spread the gospel of sanitation among a host of people who do not read the technical journals. Their splendid work in this field is widely acknowledged. The same idea might well be taken up by the American Water Works Association, as Mr. Saville suggests, through the creation of a committee on education and publicity. As Mr. Vogelson truly says, "The attainment of the desired end is through a thoroughly awakened civic conscience, which will not permit the doing of those things which are harmful to public health".

The legal aspects of better sanitation are all important. Standardization of health laws, in order that their meaning may be clear and direct, and their interpretation easy, is highly necessary. Mr. Hansen's view is that "a health department should educate its public to the need of the law before attempting to introduce the law." Well, it is true that we live in a democracy wherein it may be that the government cannot be ahead of the people; but if so it probably is to the detriment of the public. The author firmly believes in education, but also believes in the law and its enforcement. There are a few people who know what is best for the public welfare, and it is for them to direct the footsteps of the majority. The public should be led, but if it will not be led it must be pushed. Ignorance of the law, we are given to understand, is not considered a legal excuse for its violation. Similarly, ignorance of the causes of disease is no valid excuse, especially where the disease is preventable through the observance of really simple measures of precaution.

Of what consequence would be an army without a leader? The private soldier, the non-commissioned officer, the lieutenant, the captain, the major, the colonel, all do as they are told to do. The general staff directs, knowing all the confronting conditions which those under their charge cannot know. It is so in public life. Organization and system, based on knowledge and experience, should

take precedence over anarchy and what Burke referred to as "The Rights of Man".

The fourteenth amendment of the Constitution of the United States provides against abridgment of the privileges and liberties of citizens. This same fourteenth amendment is one of the hardest nuts the framer of sanitary laws has to crack. His purpose is to protect the public against itself, but in so doing he frequently runs counter to the average citizen's idea of what constitutes his privileges and liberties. Herein lies one of the chief fields of usefulness of public education, for, as the Court of Appeals of the District of Columbia recently said:

> Public opinion, keeping pace with advancing civilization, is the progressive factor which calls for an enlarged invasion of private rights for the public good, and which prompts courts to give greater elasticity to constitutional limitations.

The author's statements on pages 271, 272, relative to the manner in which water improvement projects are often handled by state boards of health, were made particularly with a view to encourage discussion of a subject which certainly deserves not only discussion, but action. With such matters handled as they now are often handled, the author contends that questions of approval or disapproval of improved water supply projects should not always come to final rest in the state boards of health.

In the discussion Messrs. Evans, Hansen, Hazen, Horton, Morse and Vogelson disagreed with the author with respect to his unnecessarily abbreviated thought as to guarantees of efficiency being sufficient to warrant acceptance of a water purification project. The author is forced to the confession that he purposely resorted to ambiguity in this reference, hoping that it might thus elicit extended discusssion of possible remedies for the existing unsatisfactory conditions.

Dr. Evans thinks the community will want the advice of experts in addition to guarantees. The author heartily agrees with him, for by "experts" Dr. Evans clearly means men qualified by knowledge and experience to pass upon such subjects. Mr. Vogelson is worried over the Patent Office files, but what the author knows of filter patent matters impels him to refuse to become frightened over this aspect of the matter. As to Mr. Vogelson's other point, namely, the problem of correcting defective work at the taxpayers' ex-

pense once it is built, the author is prone to consider as a parallel objection cases where incompetent health board engineers pass inappropriate work, which later on requires remodelling and rebuilding, or where they require needless elaborations in well conceived plans.

Mr. Hansen wonders what "tangible guarantees" may mean. The author used the term in its precise meaning, i.e., *tangible*, capable of being possessed or realized; such that one can lay the hand on it; within reach, real, as tangible security.

In issuing a certificate of approval of plans and specifications covering a given project it is the usual custom for the state board of health to tie a string to such approval in the form of a proviso that after the plant is placed in operation, if it does not give the results expected or required by the board, suitable alterations or additions must be made in order that it may do so, otherwise, the certificate of approval is invalidated. This puts the efficiency of the plant up to the operator, and no plant, however capably designed and built, can long give a good account of itself if it is turned over to the tender mercies of an inexperienced or careless operator.

This proviso, which forms an integral part of practically all certificates of approval issued by state departments of health, is in the precise nature of a tangible condition.

Mr. Hansen is correct in that the engineer does not guarantee his work, any more than a surgeon, reducing a bone fracture, gives a guarantee that the limb will set straight and sound. He may have no immediate control over his work after he leaves it. But the contractor is required to give guarantees respecting the stability of his work, even in cases where the design is the work of another engineer.

A case in point where a water filtration plant was built under a "tangible guarantee" was the contract entered into in 1907 between the Union Stock Yard Company of Chicago and the Norwood Engineering Company. The contract stipulations were that the raw water supply should be taken from foul Bubbly Creek and purified in a plant to be built by the Norwood Engineering Company. It was specified that the purification plant should be capable at all times of delivering an effluent "applicable to all uses for which the city water is applicable". It furthermore was stipulated that the cost of producing this water should not exceed $20 per million gallons. The contract specified four separate test periods, so that if

the plant failed at first such changes as the contractor desired to make could be effected and another trial made. This could be repeated three times. The period of each test was to be a maximum of two weeks. The author was referee on these tests, during the first three of which the engineering company failed in some manner completely to fulfill the guarantees. In the fourth and final test period it succeeded, the plant was accepted and the contractor paid in full.

Now there was a penalty attached to this contract. In the event of failure to fulfill the guarantees, not only would the contractor lose what money he put into the construction of the plant, but he would be compelled to remove the unsuccessful plant from the grounds of the Union Stock Yard and Transit Company. If a private corporation can exact such conditions and a company comply with and satisfy them, the author submits that any city can just as well do so. The operations of the plant were watched not only by the contracting parties but also by the health department of the city of Chicago.

This is what the author meant when referring to "tangible guarantees". It is believed that no reputable filter manufacturing company would hesitate for a minute to guarantee not only the structures they erect but also their ultimate performances conducted under the direction of trained operators. If they are called upon to guarantee the stability or performance of works designed by others than themselves they unquestionably should have the right to modify such construction details as they deem important. Furthermore, in the tests to establish the efficiency of the plant in operation, they should be given the power of approval of the operating staff.

A city making such a contract under "tangible guarantees" would thus be protected in every important way, especially if cost factors, including the cost of construction and the cost of operation and maintenance were limited. Then it would be up to the state department of health to see to it that the plant is properly operated to yield an effluent of the desired degree of purity.

It is the chief duty of state health departments to furnish the public with the maximum of protection with respect to the purity of its water supply, as in all other matters relating to health and comfort. Thoroughly well conceived, adapted and constructed works are no more fool proof than works which are poorly conceived, adapted and built. Thus is made plain the paramount necessity

for good operation of water and sewage works obtainable through the effective supervision of operation of such works by competent state health officials. The health department should constitute a strong connecting link in the chain of protection between the purification works and the public.

Where matters affecting the public health are under consideration the interested community is entitled to receive the best advice, the best service, the best protection that is available. The author's thought is that, failing to get a state board of unquestionable competency, which readily can be done if appropriations are adequate, the opportunity should in some approved manner be taken away from unqualified health departments to condemn, to modify unfavorably, or to hold up designs and construction indefinitely, where such work is under the charge of competent, experienced men. The worst that can be said of this suggestion is that it tends to a choice of the lesser opportunity for evil.

To fill his position completely and well the state board of health engineer, whose duty it is to scrutinize and pass upon the plans and specifications of his brother engineer in the open field, must be quite as good an all round engineer as those upon whose work he is passing judgment. The author submits that quite often the state board of health does not rise to this standard.

It is by no means improbable that there have been, and will be, occasions where a state board of health engineer may properly criticize, and advantageously criticize, the work of a practicing engineer of long and varied experience. Fundamentally, though, it would appear that the average practicing engineer is more likely to be right in principle than the average engineer of the state. His experience covers a wider field. A failure on his part is a distinct setback to his future prospects, and he cannot afford to take chances. He gives the best he has.

The author hopes he may be forgiven if he says that his observation has taught him that all men are prone to ride a particular hobby, or set of hobbies; but it has also taught him that an engineer designing an important public work is mighty careful to protect his reputation first by good, safe, substantial work before he ascends to the back of his hobby. The author cannot say that as a rule the engineers of state boards of health labor under this moral restraint. He admits that so far as their knowledge and experience will carry them they may be relied upon to take no chances; but they often

may be expected to display a generous inclination to "play safe" through the demand of certain elaborations in a design which are not justified, and which financially burden the community unnecessarily.

In order to fill these highly responsible positions competently such representatives of the board must have had wide experience, not only in designing work, but in the construction and operation of such plants. Without such specific experience there is a strong tendency for the state engineer to particularize on those features with which he is most familiar, and to lose sight of the broad conception which is taught only by extensive experience. Desk work will not furnish this knowledge. On the other hand, lack of broad experience in such matters may cause him to treat such questions in a somewhat perfunctory manner, and to generalize where his knowledge does not qualify him to generalize. Both of these methods are bad, one probably as dangerous as the other.

With eminent dispassion the author submits that strangely enough the general public, including the engineer, has come to view the average state board of health in the light of a quasi-celestial body, whose infallibility is certain, and whose impeccability is unquestioned. Such boards have become a sort of court of last resort in health engineering matters, and while no one would more heartily welcome the warranted mundane apotheosis of state boards of health than the author, the plane of efficiency of many such boards must be raised materially before he would be willing to grant them the unquestioned right to the broad exercise of such arbitrary power. The solution of the problem is one wherein the interested community and the engineer, as well as the state board of health, will obtain full equity and strive together to win a common goal. That condition does not now prevail.

The author submits that the requisite end would be attained if every state had a health department wherein the engineering division would be manned by well paid men who, by actual work under a wide variety of conditions, and extending over a period of years, would thus be qualified to pass upon details of design of water filtration and sewage disposal projects, having a clear conception in their minds' eye while they were studying such designs of the kind of service such works would give if built and placed in operation.

As matters now stand, whether competent or not, the rulings of state departments of health are usually accepted as final. Further-

more, whether the law under which they act gives them the power of approval and rejection, the mere withholding of a decision often furnishes enough ammunition for those opposed to a project to defeat it.

Replying particularly to Mr. Morse the author would state that it is by no means his thought that all water purification projects are amenable to the tangible guarantee idea, or that such a procedure is necessary, or even desirable, in all cases; but he does think it points the way to a remedy under certain sets of circumstances and conditions. He is in full sympathy with Mr. Morse on the proposition that in cases where a community is unwise enough to employ inexperienced engineers to lay out its work a review of such projects by the state department of health is more than ever necessary. And yet the main point still persists; it is then vitally necessary that the health department engineer shall know his business.

The author wishes to assure Mr. Morse, and the engineers of all state health departments, that his apparent strictures on this general point are intended more as a statement of broad conditions as they exist than as a criticism of the engineers themselves. He fully agrees with Mr. Morse that, having suitable laws, capable men should be employed and given ample appropriations and powers to carry them out; and that these men should not only be capable but fair and broad minded.

The author realizes all too well that up to this point his argument has been preponderatingly a destructive one, yet it is sometimes well to be somewhat iconoclastic, and in view of all the well known, but heretofore carefully avoided facts, it would appear very wise, indeed very necessary, to apply iconoclastic doctrines to state departments of health as many are now constituted, and as many now operate. The solution doubtless is to be found in a constructive policy, in the line of improvement in the personnel of such departments. This can only be effected with benefit through larger appropriations and the selection of men qualified by experience to hold these highly responsible positions of authority.

The author thinks highly of Mr. Hansen's suggestion relative to the amendment of public health laws so that "any municipality, corporation or institution which has occasion to submit plans to a state board of health, and which may not regard the requirements of the board as correct or just, can demand a reference of the matter to a commission of expert sanitary engineers to be appointed and

employed jointly by the state board of health and the party taking exception to the board's orders". This amendment might well be made to the public health laws of all states.

Mr. Hazen thinks it will be some time before it will be necessary to filter all surface waters to make them safe for human consumption. Mr. Vermeule also has something interesting to say about how the typhoid fever death rate has been lowered in some cities through improvements in the water supply other than filtration. Mr. Emerson has made some pertinent observations on this point which will bear careful reading.

The author knows that some cities in which the general health conditions are excellent, and typhoid a comparatively rare visitor, take their water supplies from surface sources and do not filter them. His view is, however, that no catchment area is so remote and inaccessible to travelers that it may not one day become dangerously polluted; and that no matter how pure a surface supply *ought to be,* because of the isolation of its source, positive assurance is lacking that it *may not* become polluted by accident or chance. To avoid that chance by filtration is certainly worth 40 cents per annum to any man.

Nevertheless, there is a world of truth in Mr. Hazen's statement that "When you get a water supply up in the Cascade Mountains it is going to be some time before the people will put up money to filter that water". There have been many notable cases among the large cities of this country where it was many years before the people put up money to filter supplies which were known to be foully polluted. Consequently, in this day, when it is a case of filtering a supply which is only *open* to pollution, like that of New York from the Catskills, the reluctance of the public to pay for absolute protection is quite as great. The author thinks, however, that Mr. Hazen was giving expression to the public mind more than to the inner convictions he doubtless holds on the matter. Even in the field of water sterilization, of which Mr. Hazen speaks so favorably, while freely admitting that it has worked wonders in typhoid reduction, it must not be forgotten that to sterilize an unfiltered water so as to obtain absolute protection is often a very difficult, if not impossible, undertaking. Sterilization of filtered waters will accomplish this end.

The author has read with great interest the instructive views of Messrs. Miller, Tribus, Curry and Pollard relative to public health education, and is entirely in sympathy with the ideas they express.

Mr. Brown calls attention to a most important point in connection with the management of water filtration plants. Why is it that so many cities fail to profit by the good example set them when their new plants are undergoing an efficiency test? As a rule high grade operators have charge of the plant at such times, and high efficiencies result; then it not infrequently happens the city places a vote collector or a cheap and inexperienced operator in control, and blames the contractor or designing engineer because the plant falls down.

What can be done by "taking account of stock" in a state health department has been well described by Mr. Horton. The statistics appear to leave little, if any, room for doubt that the widespread purification of municipal water supplies, and the close watch set upon them by the health department, have resulted in a reduction in the typhoid death rate in New York state of 67 per cent in the last ten years.

In his discussion Mr. Jackson has added another sound piece of testimony to his already long list of incontrovertible evidence against the house fly as an important factor in typhoid transmission.

Mr. Baker's comments relative to the advisability of appointing sanitary engineers for local health board work are instructive. Everyone knows, or should know, what splendid history has been made in Montclair in the past twenty years. Other cities and towns might well follow the lead of Mr. Baker's home, the Town of Montclair.

The remarks of Mr. Hill, relative to the degree to which sewage should be treated before being discharged into public waters, are in general accord with the author's views, as already expressed in reply to a question put to him by Secretary Diven.

The warning voiced by Mr. Powers respecting the dangers coming from the excreta of travelers on railroads and steamships is one which is too often entirely ignored, largely, maybe, because it is an evil so difficult to curb. On steamboats it is practically impossible to do so, and on railroad trains the porter and his toilet key respond all too readily to the silvery voice of the common medium of exchange.

The living menace to the public health offered by the typhoid carrier is set forth by Dr. Soper in a solemn and impressive manner. He also calls attention to the fact that the author "merely mentioned what is pro ably the firmest defense which the individual can pro-

vide for himself, vaccination". That is true; but the author while admitting that anti-typhoid vaccination will do much toward eradicating the disease, realizes that if it is difficult to get people to filter their water it is even more difficult to gain their consent to be vaccinated. Dr. Park well says that "water is the chief danger"; and while many of us will avail ourselves of the ounce of prevention in the form of anti-typhoid vaccine, nevertheless, as Mr. Hering remarks, while "This expedient may become in time as valuable as the anti-smallpox vaccine, this expectation must not hinder us from imparting the education now practicable regarding the dangers that face us and how they can be avoided". Again, Dr. Wiley says: "It is not likely that all of us in the near future will be vaccinated against typhoid". *The remedy is in the control of the sources of infection.*

Filtration of public water supplies stands as the sure control of the chief source of all typhoid. In all great epidemics of typhoid fever, practically without exception, the most common cause is found to be the water supply. Since water is in common use by the community its effect, when impure, must always be greater and more widespread than that from impure food.

Dr. Evans and Mr. Saville were quite right in suggesting that the excellent results accomplished by making all privies flyproof have been duplicated at Richmond. Dr. Levy, in a letter to the author, called attention to the fact that Richmond was a pioneer in this line of sanitary endeavor. Proper acknowledgment should have been made by the author in the first place, for he has long been aware of the remarkable work done for Richmond by Dr. Levy and his associates. The typhoid reduction in that city during the past ten years is a matter worthy of unstinted praise. On a basis of low typhoid death rates Richmond stands today at the forefront of all southern cities, and ahead of many northern cities.

Dr. Chapin is quite correct in his statement that it is difficult for European health officials to comprehend the importance of water borne typhoid fever in the United States. But in European countries the public health laws are better obeyed than here; and they are profiting by the experiences which this country only now is going through.

Dr. Evans calls attention to the fact that the reader is liable to get an erroneous idea of the immunity to typhoid of people past forty, when studying Table 11 of the paper. To clear up this point

table 35 has been prepared, and it is hoped that the data therein given will cover Dr. Evans' point. It will be noted from this table that the mortality rate from all causes is greatest before five and after sixty years of age, whereas the typhoid mortality is least at those ages, the greatest mortality occurring between the ages of ten and forty years.

TABLE 35

Mortality from all causes and from typhoid fever, according to age.

AGE	POPULATION OF REGISTRATION AREA		TOTAL DEATHS ANNUAL AVERAGE 1910–1913		DEATH RATE PER 100,000 POPULATION	
	Percentage distribution by age*	Total by age division	From all causes	From typhoid fever	All causes	Typhoid fever
Under 5........	10.2	6,460,000	214,142	617	3330	9.5
5 to 9.........	9.3	5,890,000	18,386	708	312	12.0
10 to 19........	18.2	11,540,000	32,836	2368	285	20.5
20 to 29........	19.0	12,040,000	65,618	3320	545	27.6
30 to 39........	15.6	9,870,000	72,634	1938	736	19.6
40 to 49........	11.8	7,470,000	77,397	1213	1036	16.2
50 to 59........	7.9	5,020,000	89,171	778	1776	15.5
60 and over....	8.0	5,070,000	273,864	667	5401	13.1

* Population of registration area in 1913 was 63,300,000.

In connection with this general point it is interesting to consider how the population in different sections of the country is made up by age groups. This is shown in Table 36. The noteworthy features of this classification are the marked superiority of the percentage of youthful people (below twenty years) in the southern states; and the sharp reduction in age percentages after thirty years. In the Pacific regions the relatively small percentage of inhabitants below twenty years of age is equally remarkable, as is the balancing effect of the relatively high percentages of the groups of greater age.

Professor Winslow is of the opinion that the susceptibility to typhoid is less in the case of those who bathe every day than in those of less cleanly habits. It would seem that this ought to be so, but the author still feels that there is a great deal in the immunity idea. Once inside the body a successful attack on the part of a typhoid germ depends upon the amenability of the subject. It may be that even in grossly unclean surroundings there is a preponderance of subjects who have become "toughened" to such things. It must

TABLE 36

Distribution of population by age.

AGE DIVISION	NORTH	SOUTH	MOUNT-AIN	PACIFIC	ACCUMULATIVE PERCENTAGE POPULATION BY AGE GROUPS			
					North	South	Mount-ain	Pacific
years								
Under 5	10.5	13.9	11.6	8.6	10.5	13.9	11.6	8.6
5 to 9	9.7	12.8	10.4	7.9	20.2	26.7	22.0	16.5
10 to 19	18.7	22.3	18.1	16.3	38.9	49.0	40.1	32.8
20 to 29	18.5	18.1	20.4	20.7	57.4	67.1	60.5	53.5
30 to 39	15.1	12.9	16.1	17.5	72.5	80.0	76.6	71.0
40 to 49	11.5	8.5	11.2	13.1	84.0	88.5	87.8	84.1
50 to 59	7.9	6.2	6.9	8.2	91.9	94.7	94.7	92.3
60 and over	8.1	5.3	5.3	7.7	100.0	100.0	100.0	100.0

be so, else every great typhoid epidemic would be more fatal in the congested districts. Mr. Vermeule has shown in his discussion how higher general death rates and higher typhoid rates sometimes hold true of the wealthier, and it is therefore to be supposed, cleaner classes. Nevertheless the author is very eager to accept Professor Winslow's conclusion that body cleanliness tends strongly to all around better health conditions.

Mr. Dittoe and Dr. Boudreau have described what Ohio is doing to reduce the typhoid toll, and the good work done is commendatory. Water filtration for 42 per cent of the population of the state has been the chief agency in bringing about the fairly low typhoid fever death rate which now obtains in that state. Health matters in general in Ohio have taken a wonderful brace in the past ten years, but much still remains to be done, for in the period 1910-1913, inclusive, Ohio ranked fifteenth as regards the typhoid fever death rate in the registration states, such large states as California, Massachusetts, Minnesota, New York, New Jersey, Pennsylvania and Wisconsin having a better record in this regard. The data presented by Messrs. Dittoe and Boudreau, descriptive of the work they are doing, are highly instructive.

In the state of Pennsylvania, as set forth by Mr. Emerson, the difficulties confronting the sanitarian are great. At present one-third of the population of the state reside in townships where there are no regularly organized boards of health. This condition is duplicated in Ohio, and unquestionably has as much as, if not more than,

anything else to do with keeping the typhoid fever death rate in these two great states, which rank second and third in population among the states of the Union, as high as it is. The discussions of the officials of these states are very enlightening as showing the great need for rural sanitary work.

Mr. Trautwine's description of how well nigh ideal health conditions were brought about in the Canal Zone brings home forcibly the truth of what can be accomplished if the methods and means are all that they should be. This wonderful piece of sanitation will ever live as the supreme accomplishment of Dr. Gorgas.

Dr. Bryce's remarks relative to the loss of life and wealth through diseases which are the sequelae of typhoid fever are pertinent. This loss is great, how great none can say. The doctor's reference to the relationship of typhoid fever and tuberculosis, one growing out of the other through depleted vitality, certainly furnishes food for thought.

Mr. Race's comments relative to the somewhat unusual typhoid epidemics which occurred in Ottawa are interesting. The 1911 outbreak occurred in January and continued through the following April; and the 1912 epidemic started in July after a period lasting several months of almost complete freedom from typhoid mortality. The cause was polluted water in both instances, and serves as good proof that none can predict when an unpurified water supply will become infected with disease germs. Some day Ottawa may filter its water supply, but the usual procrastinating formulae probably will be followed through, as has been the experience in other great cities in North America, and the prehistory of the matter be well dotted with the red marks of the usual series of preventable water borne epidemics.

Mr. Fuller has mentioned the fact that perhaps the bulk of the population now having water supplies of conspicuously unsatisfactory quality are residents of small cities and towns. How best to educate the general public to the need of pure water in these smaller communities is not easy to say. It seems to the author that Mr. Fuller has described one important way when he says that water works men ought to join actively in general public welfare movements. It is possible that in this way, through the education of the public in the general causes and methods of prevention of disease, water purification promptly will take its proper place among the

more important agencies of disease prevention, and thus be advanced with a minimum of delay.

In closing the author wishes to express his appreciation of the resolution offered by Mr. Gwinn and voted by the Association, directing the reprinting of this paper in pamphlet form for public distribution. He also desires to thank Mr. Trautwine for his efforts in preparing so excellent an abstract of the paper for use in the advance notice of the reprints. The author believes profoundly in Mr. Tribus' logic that "Even so vast in importance as is the subject, it will only be given due weight when public sentiment is aroused." Distribution of the paper and discussion in this manner may serve to carry the message into many dark quarters where light is urgently required.

DISCUSSION

THE LATEST METHOD OF SEWAGE TREATMENT[1]

By Edward Bartow

Mr. W. F. Wilcox: There is a plant at Birmingham, Alabama, which is a modification of the old Columbus, Ohio, type. When the reservoir holding 2,500,000,000 gallons of water was built, it was found that the effluent from the Columbus type of sewage disposal plant was generally unsatisfactory. The county had very little money, and was not inclined to go into the Imhoff system. The company engineers undertook to assist the county engineers to develop a modification of this practically obsolete type of sewage disposal plant. A section 120 feet square was put in, with sixteen chambers. Each one of those chambers is the inverted frustrum of a pyramid. Sewage to the extent of 5,000,000 to 7,000,000 gallons per day was passed through those settling tanks. The sludge was carried over into the digesting tank, or the tank which fulfills the function of a digestion tank in the Imhoff system. When the tanks were filled to a height that they would not hold any more, sludge water was pumped on top of this so as to add to the liquid in the digesting chamber. It was then allowed to go into the sewer system. The liquid was pumped out of this digesting chamber back into a branch of the sewer. When the sludge has become digested it is then pumped into the sludge-drying beds. The liquid from these sludge-drying beds then flows by gravity back into the main settling tank, and seems to assist somewhat the bacteriological action, the building up of the bacteria for the disposal of the sludge.

The plant is rather crude, but it is a very inexpensive modification of a very obsolete type of sewage disposal plant. This plant is handling somewhere between five and seven million gallons of sewage per day; and the total cost of reconstructing the plant, including the filters and digesting tanks, was about $75,000. What has been of particular interest is this, that when the Columbus tank was put

[1] Published in the June, 1916, Journal, vol. 3, No. 2, at pp. 327–345.

in, a great many engineers rushed to the conclusion that they had discovered a remedy for all the ills of the disposal of sewage. The speaker has no criticism to make of the Imhoff tank; but he would be very much interested to see some of our foremost engineers diverge somewhat from the Imhoff system rather than to follow the beaten track.

The scientific determinations of that plant have not been as accurate as it was hoped they would be. The speaker urged for the past three years, and is still urging the county to go into more details as to the scientific examinations of results obtained from this modification of an obsolete type, which can be put up by many communities at a nominal cost.

DISCUSSION

THE SELECTION, INSTALLATION AND TEST OF A 1,000,000 GALLON MOTOR DRIVEN CENTRIFUGAL PUMP[1]

BY S. R. BLAKEMAN

MR. SEABURY G. POLLARD: On page 562 of the June JOURNAL there are some figures given showing a comparison of the cost of a triple expansion pump as against an electrically operated pump. The triple expansion pump referred to the speaker understands is direct acting. There is a considerable amount of formulae involved, but the net result as given shows an annual cost of $2694.25 for pumping 219,000,000 gallons with the triple expansion pump, and a cost of $1203.94 a year for pumping with an electrical pump, the price of current being taken, as stated, as 2 cents per k. w. hour. Now, an investigation of this calculation shows that of that $1203.94 the labor cost is $1000, interest and depreciation $150, and maintenance $50, $1200 in all, leaving $3.94 for cost of current for the year, which is rather a remarkable showing. Running through the figures, the speaker found that the cost of current, instead of being $3.94, would be $3940; making the total cost for operating the electrical plant $5140, instead of $1203.94, about double the cost of operating the reciprocating pump. The reason for calling attention to this is only because this paper gives out the impression that pumping by electrical current at 2 cents per k. w. hour is more economical than pumping by steam. That is not the case. The cost is just about double, in this particular instance.

MR. S. R. BLAKEMAN: The author's computer made an error; the cost of current should be 56 mills, based on coal only. With the motor driven pump C should equal $2313 and the saving over steam pump equal $301.25.

[1] Published in the June, 1916, JOURNAL, vol. 3, No. 2, at pp. 557–580.

Mr. D. A. Reed: The City of Duluth was operating in 1908 two 5,000,000 gallon triple expansion condensing engines. In that year there was installed in the same pumping station a 12,000,000 gallon 2-stage electrically operated centrifugal pump. A comparison was made that year with the steam pumps that had been operated in previous years; and the details of that cost are reported in the 1909 report. A copy of that report can be obtained by writing to the Water and Light Department of Duluth. The speaker is sorry that he cannot give the figures in detail; but the total cost for the entire year under the operation of the electric pump was slightly under that of the steam pumps. The cost for electric power was about 0.4 per k. w. hour; and in comparison of costs of course the cost of the investment was included, and interest and depreciation on both plants. There is not much of a saving in the use of an electric pump; but there is a large saving in the amount of space required for that pump, which is not taken into account in the comparison. It also gives a little better factor of safety. If you are going to have insurance against interruption of steam pump service it is better to install an electrical pump than a duplicate steam pump. Sometimes there is difficulty in getting coal supplies, and considerable trouble was experienced from the boiler and the breakage of engine parts.

Mr. S. G. Pollard: How can a safer service be obtained electrically than with a steam plant? With electric power you are dependent upon the output of some other company rather than upon your own power plant. When the possibility of trouble with that plant and the chances taken with the overhead wiring are considered, especially if the fire hazard of the community is taken into account, it would appear much safer to depend upon the isolated steam driven pumping plant. Unless power is furnished from two different sources and over two lines of wire well separated, it would not be particularly safe, from a fire protection standpoint, to run a water works that way. There are of course individual cases in which it might be desirable. As to the cost of operating a plant electrically as compared with steam, the speaker has made a number of such comparisons and has usually found that electric current should be obtained at from five to seven mills per kilowatt hour to compete.

President Hill: The speaker's experience in that regard has been identical with that of Mr. Pollard. He has never been able to

figure that electrical pumping is as cheap as steam pumping, unless the current can be brought down to a price around 0.6 cent, the exact figure depending upon the efficiency of the steam pumps. He has encountered the electrical pumping proposition on a number of occasions, owing to the activity of the commercial agents of the electrical companies trying to convince clients that an electrically driven pump was the thing to adopt. The occasions where an electrical pump may be introduced for economy's sake are very rare, indeed, except in very small installations.

Mr. D. A. Reed: At times there is difficulty in getting a coal supply at Duluth. Some interruption of service was experienced from weak parts in the engines, which must of necessity be somewhat complicated and more liable to breakage than a centrifugal pump. The electrical service has been excellent during the seven or eight years that it has been in operation; there have been only a few instances where the current was off for an hour or two at a time. The current is furnished by a large hydro-electric plant, which gives very excellent service. We find one advantage, that when the reservoir is shut off for repairs we can give direct pressure with the centrifugal pump much better and safer than we could with a steam pump.

AN EPIDEMIC OF TYPHOID FEVER DUE TO THE USE OF A POLLUTED WATER SUPPLY AT THE 1915 ASSEMBLY OF OLD SALEM CHAUTAUQUA[1]

By Harry F. Ferguson[2]

There resulted from the use of a polluted water supply at the 1915 Assembly of the Old Salem Chautauqua a large epidemic of typhoid fever which, though presenting nothing new from an epidemiological standpoint, serves to emphasize the danger of incurring typhoid fever infection at summer camps and picnic grounds where insanitary conditions are allowed to prevail and adequate attention is not given to the quality of the water supply. Sanitarians have realized that there is a tendency for persons to more or less abandon sanitary precautions while camping or on summer vacations to the country, and much has, therefore, been written on this subject warning people of the dangers involved. However, owing to the coming and going of vacationists and the scattered location of their homes it has generally proven difficult to obtain data on any large outbreak coming from a summer camp. In the Old Salem epidemic we have a striking example of such an outbreak, and it should serve as a warning to vacationists and to the management of summer resorts. The Old Salem Chautauqua Association, like many others, did not exercise due care, trusting to luck that nothing would happen and the experiment proved costly both in dollars and in the loss of lives.

The Old Salem Chautauqua grounds, comprising about 60 acres, are located in Menard County, Illinois, about a mile south of Petersburg. The Sangamon River, flowing in a northerly direction, forms the western boundary. The topography of the grounds is very pronounced with the exception of the northern part, where it is very flat and subject to overflow at high stages of the Sangamon River. Chautauqua assemblies have been held since 1897, or for 18 years, and there have been constructed in this time many buildings, including an auditorium, hotel, bathhouse, memorial and society

[1] Presented at Meeting of Illinois Section, January 25, 1916.

[2] Assistant Engineer Illinois State Water Supply.

buildings, and slightly over one hundred private cottages. The cottages are occupied by the owners and their friends during the assemblies and in addition many tents are erected to accommodate other campers. The Old Salem Chautauqua assemblies have been remarkably good, and have gained a widespread reputation. This

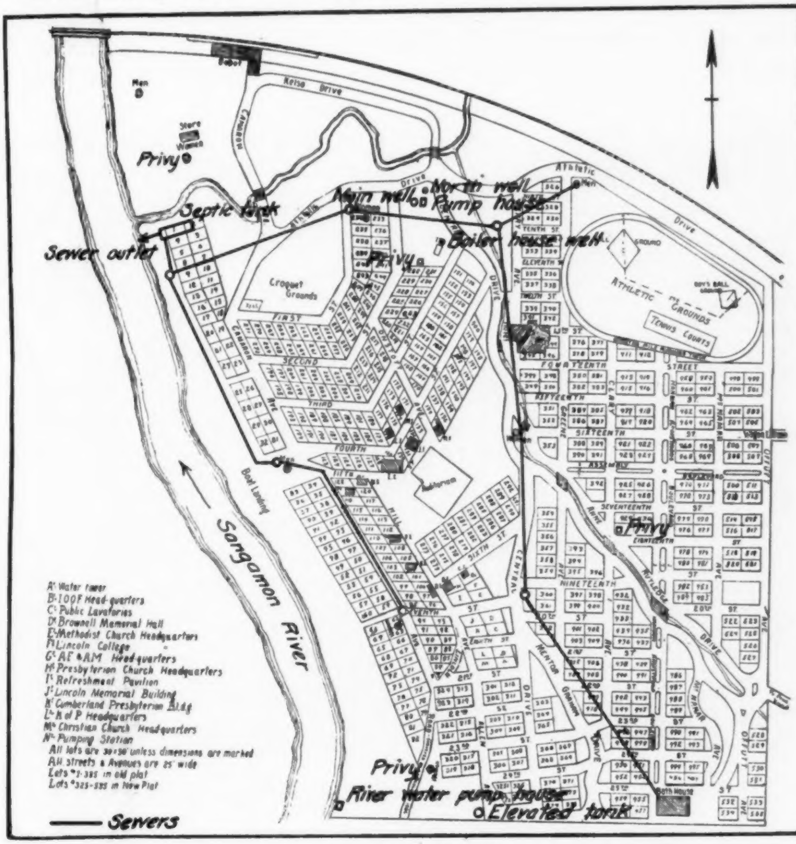


FIG. 1. PLAT OF THE OLD SALEM CHATAUQUA GROUNDS, SHOWING LOCATION OF WATER WORKS AND SEWER SYSTEM

is shown by the fact that in 1905, 4000 people, coming from thirty-three states and territories and five foreign countries, lived on the grounds. Due to the advent of traveling Chautauquas the attendance has fallen off of late years, and the estimated daily attendance during the 1915 assembly varied between 500 and 3000.

In the early days of the Chautauqua public water supply and sewerage systems were installed. The sewer system covers practically the entire grounds and the sewage, after passing through a septic tank, is discharged into the Sangamon River at the northwest corner of the grounds.

There are two separate sources of water supply, namely, a supply from wells for domestic use, and a supply from the Sangamon River for the bathhouse, for flushing purposes and for use in the hotel

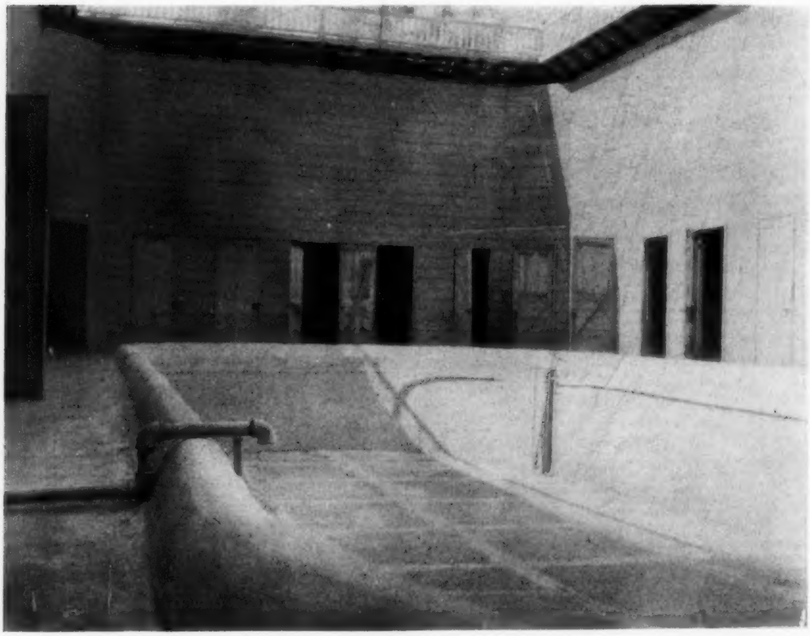


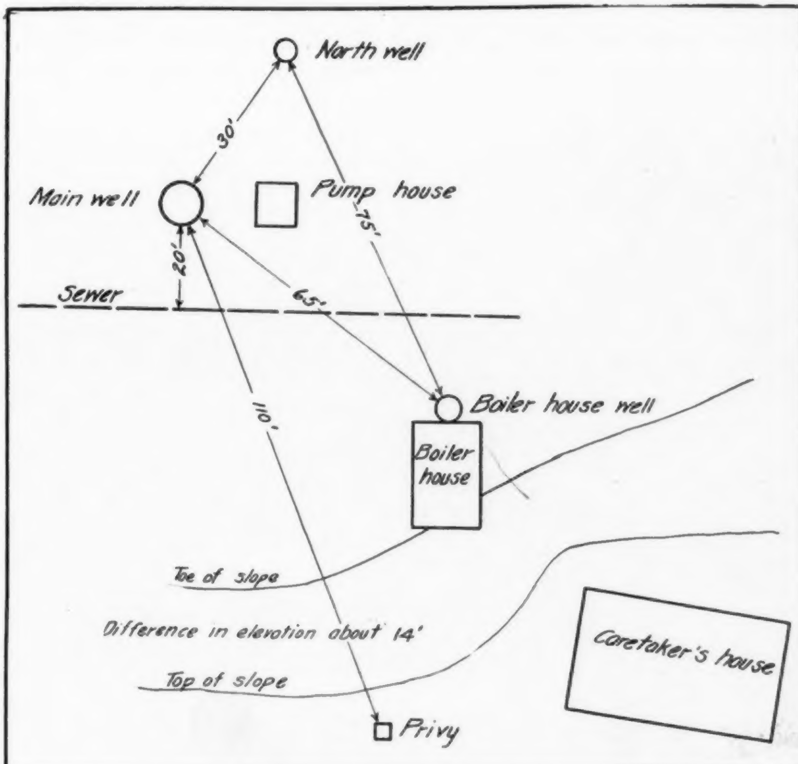
Fig. 2. Interior of Bath House and Swimming Pool

kitchen. Polluted river water might well have caused typhoid, especially as used in a swimming pool at the bathhouse, but since there is no evidence that such was the case at this time, the river water supply will not be dwelt on here. It may be noted in passing, however, that a few cross connections between the river water and well supplies controlled by single valves existed in a few cottages.

The domestic supply is obtained from three dug wells located

on the low land at the northern end of the grounds (figs. 3 and 4). One of these wells which furnishes most of the water is designated the main well, and the other two, the north well and boiler house well, respectively.

The main well is about 8 feet in diameter and about 33 feet deep



Sketch Showing General Layout
Old Salem Chautauqua Water Works
September 1915

FIG. 3

below the ground level (figs. 5 and 6). The walls, which consist of two rings of brick laid with horizontal joints cemented, extend about 5 feet above the level of the ground, and are surrounded by an earthen embankment. Surmounting the walls is a conical

wooden roof. The walls are not water tight at any level and where a suction pipe enters the well several bricks have been removed. The earthen embankment is about 6 feet wide at the top and has side slopes of about 1:1. There is a hole in this embankment along the top of the suction pipe leading to an adjoining pump house and in addition there are several holes on the outside of the embankment evidently burrowed by field mice or other animals. Water is drawn from this well by means of a steam driven pump

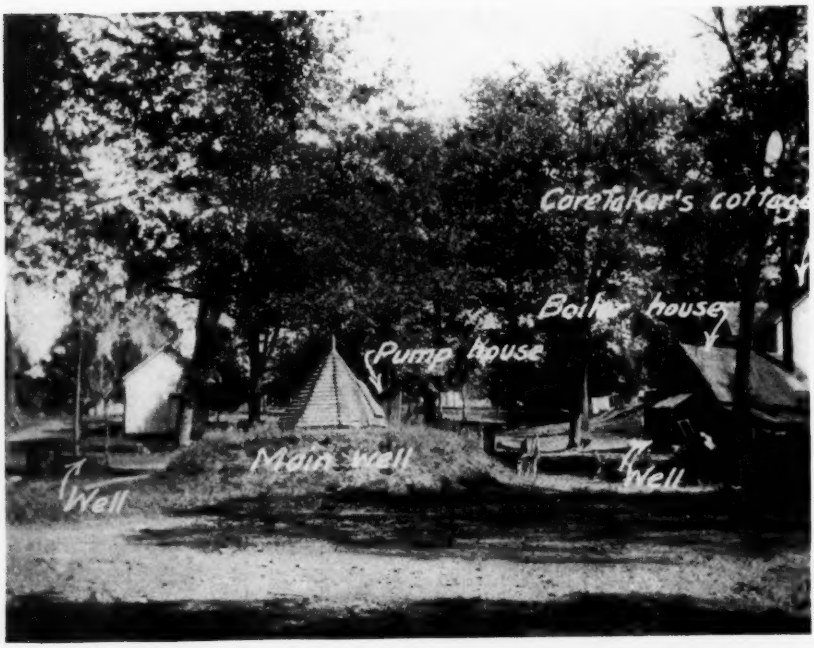


Fig. 4. Waterworks

and discharged into a distribution system to which is connected an elevated tank.

The boiler house and north wells are also dug and walled with brick and are about 25 to 28 feet deep respectively. The walls of each rise only a few inches above the ground and are surmounted by plank covers which are not water tight. Both of these wells are provided with hand pumps, and in addition may be drawn on by a steam pump located in the top of one of them and discharging

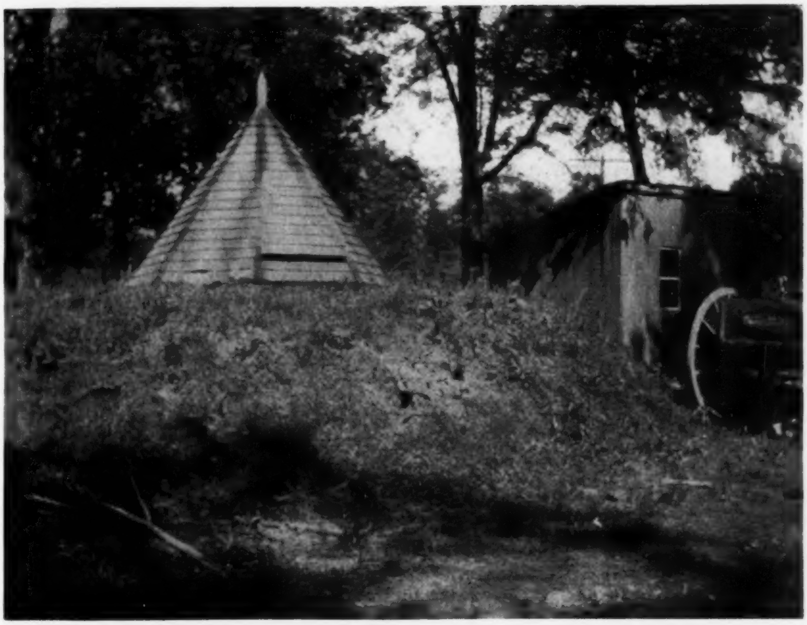


FIG 5. MAIN WELL AND PUMP HOUSE

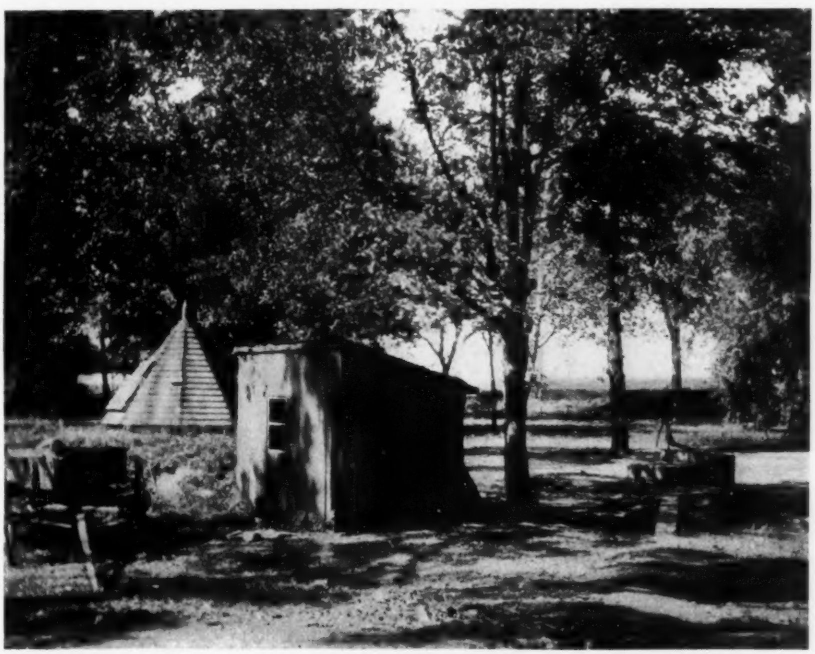


FIG. 6. MAIN WELL, PUMP HOUSE AND NORTH WELL

into the distribution system. This steam pump was not operated during the 1915 assembly.

The ground formation at these wells consists of a few feet of top soil, then a layer of clay to about 15 feet below the ground level, and then sand and gravel. The height of the water in the wells is materially affected by weather conditions and by the stage of the Sangamon River.

All three wells are subject at all times to more or less contamination. A sewer passes within about 16 feet of the main well and a privy is located only about 110 feet away and on ground about 14 feet higher than that at the wells and draining towards the wells.

The most serious danger of contamination, however, is by flood waters of the Sangamon River, and it was contamination in this manner that caused the outbreak of typhoid. The pollution carried by the Sangamon River water consists of the sewage of Springfield entering 27 miles upstream, possible wash from privies on the watershed between Springfield and the Chautauqua grounds, and the sewage from the Chautauqua grounds itself. Assuming a velocity of three miles per hour it would take only nine hours for the sewage of Springfield to reach the Chautauqua grounds.

The wells had previously been flooded during an assembly in 1907 resulting in a large outbreak of diarrhea. The cause of this diarrhea was so apparent at that time that the sickness became locally known as the "Chautauqua Quickstep." Thus the Chautauqua Association was aware of the dangers involved in continuing to use these wells as a source of water supply. Moreover, the State Water Survey, on the basis of analyses, had on three separate occasions notified the Chautauqua management that the water was not safe and should not be used unless boiled.

The 1915 assembly was held from August 11 to 25, inclusive. A few days before the close of the assembly, namely, on August 20 and 21, heavy rains occurred causing the Sangamon River to rise rapidly, overflow its banks, and inundate the northern part of the Chautauqua grounds where the wells are located. The flood waters submerged the north and boiler house wells and entirely surrounded the main well, rising within a few inches of the top of the earthen embankment. Unquestionably the polluted water seeped through the earthen embankment aided by the small holes of burrowing animals, for the water became quite turbid.

The pump pit became flooded but the pump was operated for

a while submerged, and since the water is pumped into a distribution system to which is connected an elevated tank (fig. 7), this polluted water was available for use under pressure during the last three or four days of the assembly.

When the well water became turbid and had a bad odor due to the pollution by the river water signs were placed on one or two

Fig. 7. Elevated Tanks

taps in the grounds, but many did not see these signs and others did not heed them. The water continued to be served at the hotel and restaurant.

About a day after the wells became polluted cases of diarrhea began to develop and the first case of typhoid fever occurred on September 1, ten days after the pollution took place. The actual

number of cases of diarrhea was not ascertained, but an estimate of 500 would be very conservative. Many of these were severe and prolonged and constituted a serious though non-fatal forerunner of the typhoid outbreak.

The detailed classification of the typhoid cases and the usual epidemiological evidence which was obtained relative to the milk, water and food supplies in order to determine the source of infection will not be presented here. In brief it may be stated that the epidemic of typhoid was very explosive in character involved a large number of cases, and though centering at Petersburg, Illinois, was widespread in extent even affecting communities outside the state. In all, 26 incorporated communities were affected and the most remote cases were two persons who were taken sick while visiting in California and entered a hospital in San Francisco. The first case occurred on September 1 and from then on there was a rapid development of cases until the middle of the month when about 150 cases were under care of physicians. During the latter half of the month new cases still continued to develop but in fewer numbers daily, and only a straggling of thirteen cases occurred during October. Most of these October cases, as well as a few of the later September cases, were found upon investigation to be of secondary origin, having received their infection from earlier patients.

In all, records were obtained of 201 cases of typhoid and although the infection was very severe only thirteen deaths were reported. Probably both the morbidity and mortality rates were higher than this since neither cases nor deaths were consistently reported and it was impossible to know or communicate personally with all persons who had been exposed to the infection.

DISCUSSION

Mr. Paul Hansen: It is idle to endeavor to prevent the dissemination of typhoid fever by a polluted water supply by warning people against the use of the water, unless boiled or treated with hypochlorite, or in some other way rendered safe. This is not only illustrated very forcibly in the epidemic described by Mr. Ferguson, but it was also clearly brought out during the year 1904 in Columbus, Ohio. In the early part of that year there had been a typhoid epidemic of large proportions which was definitely traceable to the polluted city water supply. The public was warned

to boil the water, both through notices in the newspapers and by handbills left at every residence. Following this, a canvass was made of the city to ascertain if the people had heeded the warning. This canvass showed that only 33 per cent of the people had taken the precaution recommended.

The epidemic described by Mr. Ferguson is very significant of the danger lurking in the water supplies of Chautauqua grounds, summer resorts, fair grounds and other places where people congregate in the summer time. This work of Mr. Ferguson's which was done while employed by the State Board of Health has confirmed the board in a determination previously reached, that all Chautauqua grounds, summer resorts and fair grounds, should be investigated before the next open season.

Water is spoken of so often in connection with typhoid fever that in the minds of some, it has become almost, if not quite, the only cause of typhoid. There are many other causes of typhoid fever, some of which are very difficult to trace. Notable among these are oysters eaten raw. There is now under way an investigation by the State Board of Health of a mild epidemic of typhoid fever centering in Champaign, but also extending to a number of nearby communities. The evidence thus far obtained makes it appear quite certain that the great majority of the cases were infected by polluted oysters eaten raw. The efforts now being made are to ascertain the exact source of the polluted oysters and to learn if these same oysters have caused outbreaks of typhoid fever elsewhere. Though the evidence with reference to this phase of the work is not complete, it would appear that oysters from the same locality have caused epidemics in certain places in Indiana and Pennsylvania.

L. A. Fritze: To eliminate typhoid epidemics among those who attend Chautauqua, go camping, etc., the health department in Moline, Illinois, gives away free of charge a four ounce bottle of chloride of lime to all citizens leaving on a vacation. A great many people camp along the Mississippi River using a water taken from a well situated possibly 10 feet from some outhouse. A number of these wells have been tested, showing a very badly polluted condition. The scheme was first in operation last year so the time is too soon to have shown results.

Mr. H. P. Letton:[1] In connection with the statements regarding typhoid fever in camps at Chautauquas and similar gatherings, the speaker would like to call the attention of the local or state health authorities to sanitary conditions, and especially to water supply conditions, on board excursion steamers operating intrastate on the Illinois River.

In connection with the work of the United States Public Health Service, regarding water supply conditions on vessels operating in interstate traffic, it was found that at Peoria, and possibly other points on the river, excursion steamers were being operated which did not come under our jurisdiction.

Some few samples were collected from these vessels, however, and almost uniformly they gave bad results. It is the belief of the speaker that this matter should be handled by the local authorities.

[1] Sanitary Engineer U. S. Marine Hospital.

THE SECTIONS

CANADA

The cup offered by President Hill to the Section showing the largest percentage of gain in membership during the year was awarded to the Canada Section, showing a gain of 35 per cent. This cup will be retained by the Canada Section until the next convention when it will go to the section showing the largest percentage of gain in membership this year. Any section winning the cup for three consecutive years will be entitled to hold it.

The Association badges awarded to the member of each section who individually secured the greatest number of members were won as follows: Canada, H. G. Hunter; Illinois, Edward Bartow; Iowa, Jack J. Hinman, Jr.; 4-State, Charles R. Wood; New York, Robert E. Milligan; Southern, William F. Wilcox.

CENTRAL

The annual meeting of the Central States Section will be held at the Hollenden Hotel, Cleveland, Ohio, October 10th and 11th. This will be the first meeting since the amalgamation of the Central States Water Works Association with this association, and a large attendance is expected.

4-STATE

A meeting of the 4-State Section of the American Water Works Association was held at Atlantic City, Saturday, April 8, 1916. A paper was presented by Mr. William W. Brush, entitled "Freezing of Water in Subaqueous Mains Laid in Salt Water and in Mains and Services Laid on Land," which brought forth a great deal of able and interesting discussion. The paper and discussion will be published in a later edition of the Journal. Mr. Van Gilder described the proposed salt water mains to be constructed along the beach front at Atlantic City in a most interesting manner, which also was discussed at length.

ILLINOIS–IOWA

A meeting of the Iowa Section will be held in Davenport, Iowa, October 10, 1916, and a joint meeting of the Illinois and Iowa Sections will be held in Moline and Rock Island, Illinois, October 11. Papers will be read and discussed, and an interesting program has been arranged. Visits of inspection will be made to the various filter plants and pumping stations in Davenport, Moline and Rock Island.

MINNESOTA

A petition for the formation of a Minnesota Section was presented at the last convention, signed by twenty active members residing in the state of Minnesota, and received the favorable action of the Executive Committee. Following is the constitution of the new Section:

CONSTITUTION AND BY-LAWS OF THE MINNESOTA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION

ARTICLE I. This Association shall be known as the "Minnesota Section of the American Water Works Association."

ARTICLE II. The object of this organization shall be the same as that of the American Water Works Association, namely, "The advancement of knowledge of the design, construction, operation and management of water works, and the encouragement, by social intercourse among its members, of a friendly exchange of information and experience."

ARTICLE III. The headquarters of this Section shall be at the University of Minnesota, Minneapolis, Minnesota.

ARTICLE IV. The membership shall consist of the members of the American Water Works Association residing in the State of Minnesota.

ARTICLE V. *Section 1.* The officers of the Section shall consist of a Chairman, Vice-Chairman, Secretary and Treasurer, who shall perform the duties usually incumbent upon such officers. These officials shall constitute an Executive Committee. They shall hold office for one year, trustees three years, or until their successors are chosen. Vacancies in the list of officers may be filled by the Executive Committee.

Section 2. At least thirty days before each annual meeting of the Section, the Secretary shall mail to each active, honorary and corporate member a blank upon which the member may express his choice for the Chairman, Vice-Chairman, Treasurer and one Trustee. The Secretary, in conjunction with two other members appointed by the Chairman, shall count all nominating ballots before the date for the annual meeting. The three members who shall have received the greatest number of nominating ballots for each office shall be voted on by ballot by the members present at the annual meeting. The Secretary shall be appointed by the Executive Committee.

Section 3. The Treasurer shall submit all bills to the Chairman of the Section before payment and shall perform the duties required under Section 4, Article X of the Constitution of the American Water Works Association.

Section 4. Twenty members shall constitute a quorum for the transaction of business.

Section 5. At the regular meetings of the Section the business shall be conducted in the following order:

Reading of Minutes,
Report of Officers,
Reports of Committees,
Miscellaneous Business,
Announcements,
Reading of papers and discussions,
Adjournment.

Article VI. *Section 1.* The meetings shall be held annually at such time as shall be ordered by the Executive Committee. The place of meeting shall be the University of Minnesota, Minneapolis, Minnesota, but the Executive Committee shall have power to change the place of meeting if, in its judgment, it seems desirable to do so.

Section 2. Special meetings may be called by the Executive Committee or upon written request of twenty members in good standing, In case of such a special meeting, the object shall be definitely stated and no other business shall be transacted.

Article VII. No rules or by-laws of this Section shall be inconsistent with the Constitution and by-laws of the American Water Works Association.

Article VIII. The constitution and by-laws may be amended by two-thirds vote of those present and entitled to vote at any regular meeting of the Section. Such amendment shall be in effect after approval by the Executive Committee of the American Water Works Association.